# SCIENCE

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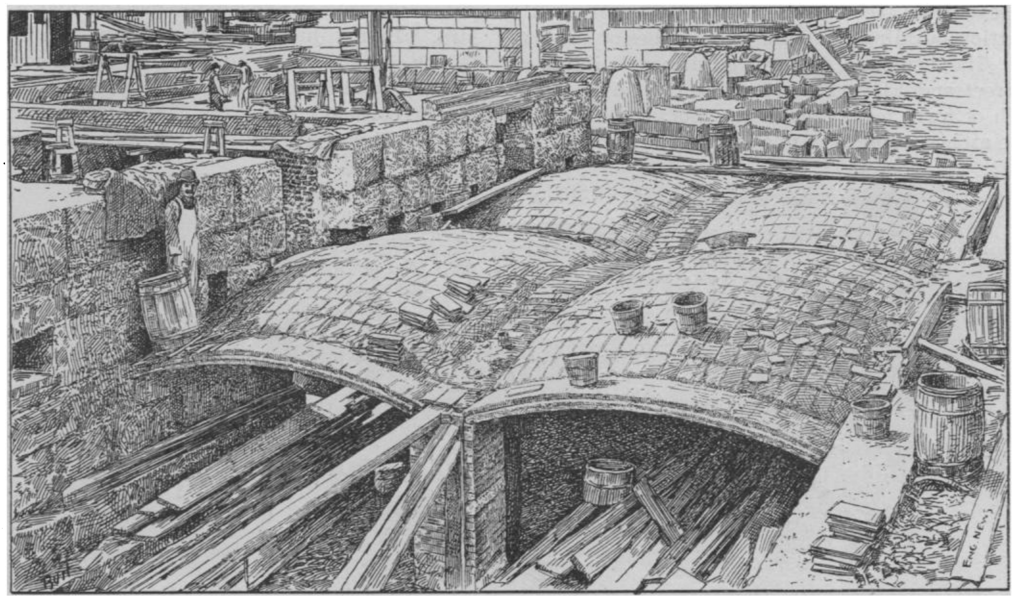
## A NEW SYSTEM OF FIRE-PROOF FLOOR-CONSTRUCTION.

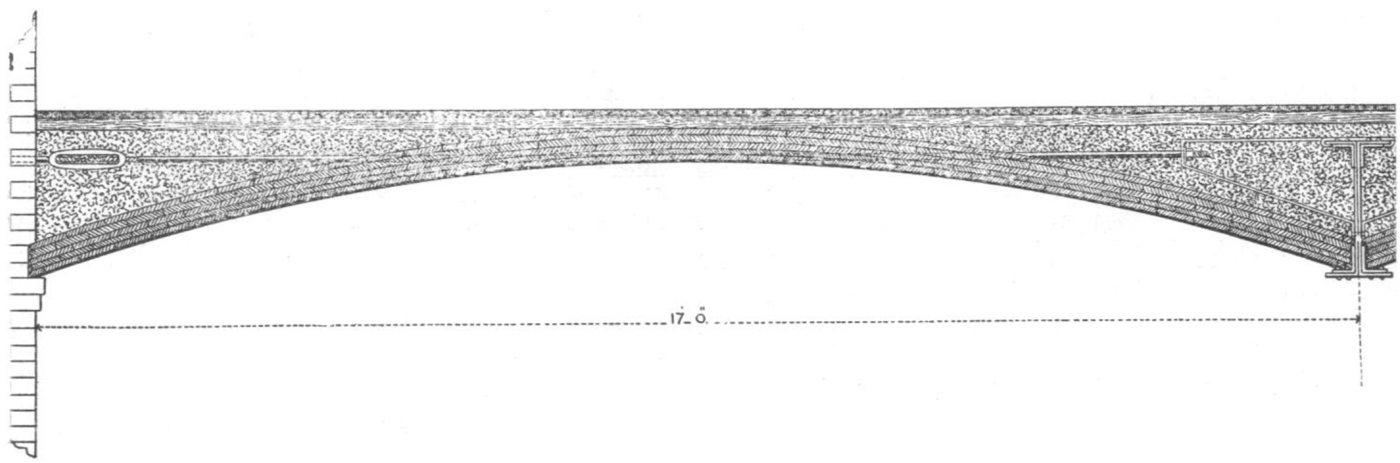
THE Guastavino Fire-proof Construction Company of this city is now introducing a new system of fire-proof floor-construction, which has many features of superiority to the ordinary system, and is especially valuable in that it reduces the cost of a fire-proof floor by nearly one-third.



TILE ARCHES IN NEW PUBLIC LIBRARY BUILDING, BOSTON.

The general features of the construction, as described in the *Engineering News*, are the use, to form the arches, of a hard, well-burnt clay tile, about one inch thick, six inches wide, and twelve inches long, laid flat, with the several courses breaking joints. A very light centring is used, and the first layer of tiles is laid with a quick-setting mortar, composed principally of plaster-of-Paris. The other layers are laid in a mortar composed chiefly of Portland cement. Its exact composition is a secret; but it adheres so closely to the tile, and is so firm and solid when it has fully hardened, that its strength is about equal to that of the tile itself, and the whole arch is practically a monolithic mass, showing no tendency to separate at the joints more than at any other point.

These tile arches are built in spans of five feet and upward, and either as plain cylindrical arches or as dome arches, as shown in the perspective view. The weight of the tiles is about one hundred pounds per cubic foot: hence an arch built of three layers of tile, which may be used for spans as great as twelve feet, will weigh about thirty-five to forty pounds per square foot, or but little more than half the weight of the brick



A NEW SYSTEM OF FIRE-PROOF FLOOR-CONSTRUCTION, ARION CLUB BUILDING.

arches as ordinarily constructed. The principal saving, however, is in the reduced number of beams used, owing to the considerably greater span which may be made with the tile arch. The prices for the work vary, of course, with the span and number of courses, and also with the location and size of the building under contract.

The system is by no means an experimental one, as a large number of buildings have already been erected with it, and many others are in process of construction. Among notable buildings in and near New York City, employing this method, are the Mount Sinai Hospital, the Young Women's Christian Association building, the Plaza Hotel, and the two new Edison Electric Illuminating Company's buildings. The new Public Library building at Boston is also being built by the system, and some of the domed arches under construction are shown in the accompanying engraving, made from a photograph. The other engraving shows the arches in the Arion Club building at Fifty-ninth Street and Park Avenue. In the Arion Club building the arches are seventeen feet span. In the Young Women's Christian Association building there are some arches of twenty-nine feet span. The company is now erecting a building at Fifty-seventh Street and Eleventh Avenue in this city, which will have an arch of forty feet span for the roof.

With these tile arches, some very fine architectural effects are possible. Where it is desired to leave the soffit of the arch exposed, a special flanged tile can be used which shows no joints when laid. Where desired, also, enamelled tiles can be used for the soffit, of such color as the architect may desire.

The great points of excellence claimed for this type of construction, however, are cheapness and great strength. In the construction of the Boston Public Library building, a heavy iron column fell from a derrick, and went end first through one of these arches. The arch, however, was not shattered by the blow, but remained solid and unharmed except for the hole broken out where the column went through. This system of construction has been in use in Spain for a number of years, and some notable buildings have been erected by it. One which should interest factory-builders in this country is a one thousand loom silk-mill at Barcelona, 371 feet by 330 feet in size. The weaving-room occupies the whole of one floor, and its arched ceiling is supported by 336 iron columns.

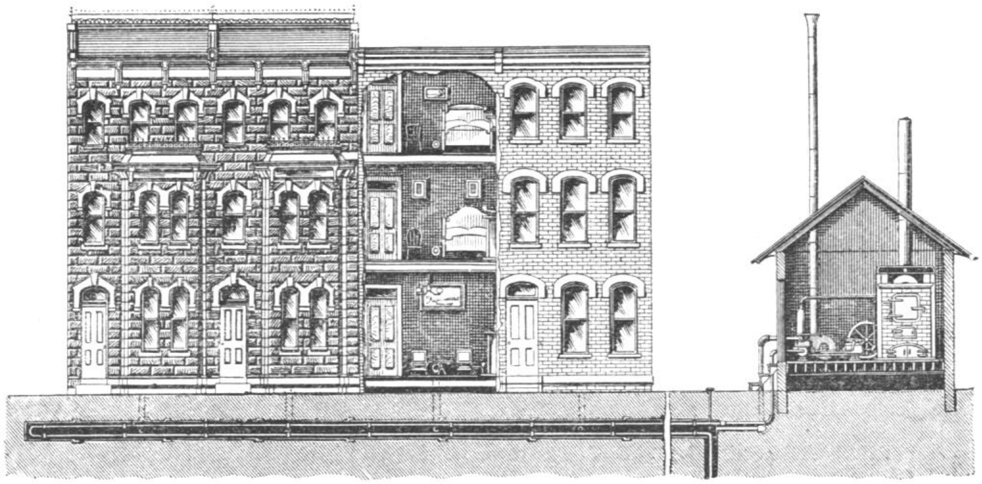
## WAR-BALLOONS.

IT has hitherto been generally believed that the Montgolfier or hot-air balloon cannot be used in tropical climates. If this were true, ballooning for war purposes would of course be impossible in places where coal-gas could not be obtained. We learn from the London *Times* that Mr. Percival Spencer, who has been making a series of interesting balloon experiments in Central India, has succeeded in showing that the theory is without foundation. At Secunderabad, in presence of the garrison and a crowd of European and native spectators, he lately made an ascent in his patent asbestos balloon. The inflation was effected by the burning of methylated spirit inside the balloon, which was held in place by twenty-five soldiers of the Bedford regiment until the word to let go was given. After rising to a considerable height, the aeronaut descended by means of his parachute. The spot where the ascent was made is over two thousand feet above the level of the sea, and the achievement was all the more remarkable because of the sultry climate and the great rarity of the air.

## HEAT AND VENTILATION.

To every man, woman, and child in this country this is an important and interesting subject. Science has made more progress in almost every other direction than in this, and naturally all improvements in heating and ventilating are carefully examined. The Hon. Hugh O'Brien, ex-mayor of Boston, at a public meeting and in addressing the mayors of New England, said, "In my judgment, there cannot be found in the city of Boston one single public building which could be considered as properly ventilated, and I would strongly recommend a fair and careful consideration of the Timby system of ventilating."

This Timby system is now attracting universal attention, especially in New England, and we are gratified to be able to present to our readers the plan given herewith, showing the manner in which this system is introduced. It is applied here as a street system, pure heated air being introduced into all the houses on a line of street from a centrally located plant, precisely as gas and water are introduced. Pure fresh air is received through a pipe at an elevation above the surrounding houses, and this air is driven by a fan through a conduit, and over pipes filled with hot water, at such a pressure as admits of its being distributed into all the apartments of any house on the line. This heat being regulated by a register in the various rooms, the temperature can be secured as desired. Not only can this be accomplished, but, when so desired, the air can be cooled; so that in Southern climes, or during heated terms, each house on the route can be made perfectly comfortable. So much for the street or city system.



THE TIMBY SYSTEM OF HEATING AND VENTILATING.

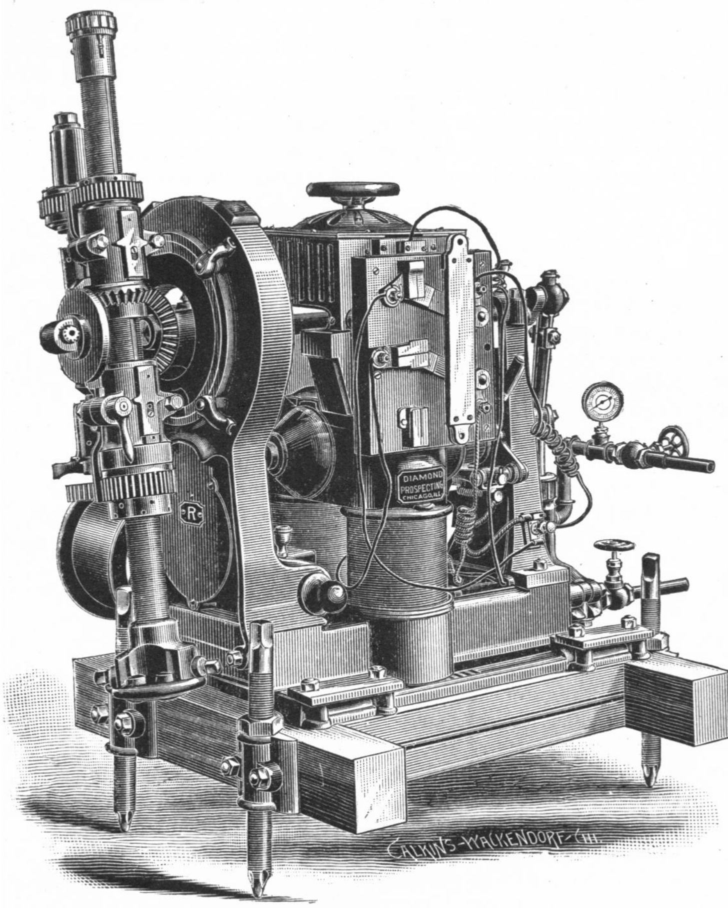
When required for a single building, say a schoolhouse, church, or hospital, the plant can be placed in the basement, and the fresh air brought from above, driven in the same manner into all the rooms, heated or cooled as desired. When necessary, a disinfectant can be used, and a block of houses, a street, or city thoroughly fumigated in a few minutes. The adoption of the Timby system for our schoolhouses will insure to every scholar the amount of fresh air changed as required, which at present is the crying want of our educational system.

With the great progress in cooking by gas, it is not unreasonable to suppose that eventually the demand for fuel for use in

our dwelling-houses will be entirely done away with. Already, within a few months past, companies have been formed, for the purpose of introducing this important and necessary invention, in Washington, D.C., Boston, Mass., and Portland, Me ; and others are in process of organization in Providence, R.I., New York City, and Hartford, Conn. Parties wishing information on the subject can address the secretary of the New England Heating and Ventilating Company, 85 Water Street, Boston, Mass.

## AN ELECTRICAL DIAMOND-DRILL.

THE electric motor is rapidly winning an important place for itself in mining operations. Already there are electric coal-cutting machines, electric hoists, electric mine locomotives, and electric drills, some of which have been described and illustrated in these columns. One of the latest devices in this




AN ELECTRICAL DIAMOND-DRILL.

line, the Sullivan electric diamond-drill, operated by a Thomson-Houston motor, is shown in the accompanying illustration. In the form shown, the drill is intended mainly for prospecting, though of course it is equally well adapted to underground work. One of the difficulties heretofore encountered in using diamond-drills in underground work, as well as in prospecting where the ground is rough or mountainous, has been that of getting power to operate the machine. By the use of electric power, however, this difficulty is entirely overcome. The dynamo may be located at any convenient point, and the current transmitted to the drill by insulated wire in the usual manner.

This machine is compact, occupies but little space, and may be operated by any intelligent workman. It will drill a hole to a depth of three hundred feet, and in any direction, the drill being fed forward by a friction feeding device at a speed proportioned to the hardness of the material operated upon. The machine is manufactured by the Diamond Prospecting Company of Chicago.

## THE ELECTRIC-LIGHT CONVENTION.

THE eleventh convention of the National Electric-Light Association was held at Kansas City, Mo., on Feb. 11 to 14, the sessions being held in the Coates Opera House. When the convention was called to order by the president, E. R. Weeks, there were about one hundred and fifty members and guests present, the attendance increasing to three hundred before the convention ended. After an address of welcome by the mayor of Kansas City, President Weeks briefly reviewed the growth of the association, and outlined the programme arranged by the executive committee. The rest of the session was taken up by routine business.

On the 12th the committee on the abolition of duty on copper presented its report, and recommended that all members place themselves in communication with their respective members of Congress, with the view of securing the removal of the duty on copper. The committee on standardizing potentials on electric street-railways and that on harmonizing insurance and electrical interests presented reports, which were full of interest, and evoked considerable discussion. The papers read at this session were one on central-station construction, by C. J. H. Woodbury, and one on the history and theory of the steam-engine, by F. E. Sickel.

On Thursday the 13th, after the reading of communications and action thereon, George E. Palmer read a paper on the economic generation of steam, written by George H. Babcock. After this and the papers of the previous session had been discussed and commented on by the members, a paper entitled "A Recent Edison Central Station and the Results thus far obtained" was read by C. J. Field. This paper brought out a long and interesting discussion. T. Carpenter Smith followed with a paper on a universal system of central-station accounts. At the afternoon session the following papers were read and discussed: "The Cost of the Products of Central Stations," by A. J. DeCamp; "Nine Years with the Arc-Lamp," by M. D. Laws; "Arc-Light Carbons," by E. F. Peck; "How our Paths may be Paths of Peace," by H. W. Pope; and "Safety and Safety Devices in Electrical Installations," by Professor Elihu Thomson. The report of the committee on data was then received, and a resolution adopted petitioning Congress to authorize and direct the superintendent of the census to collect certain data in relation to the electrical industry in addition to that already provided for by law, and asking for a special appropriation of fifty thousand dollars to carry on the work.

On Friday, the last day of the convention, the following papers were read and discussed: "Electricity as applied to Street-Railways," by F. J. Sprague; "Prodigality in Economy," by C. C. Haskins; "Line Insulation from the Standpoint of Practical Experience," by C. A. Harber; and "How to locate Grounds on Arc-Light Circuits," by J. E. Lockwood. At the afternoon session, after an exhibition of and address upon the phonograph and graphophone, by E. H. Johnson, committees were appointed on the revise of the by-laws and constitution of the association, on underground conduits and conductors, and on the relations between parent companies and sub-companies.

The officers for the ensuing year are as follows: president, M. J. Perry of Providence, R.I.; first vice-president, E. A. Maher, Albany, N.Y.; second vice-president, C. L. Edgar, Boston; executive committee, C. R. Huntly (Buffalo, N.Y.), chairman, E. R. Weeks (Kansas City), James E. English (New Haven, Conn.), J. J. Burleigh (Camden, N.J.), M. D. Law (Philadelphia), M. J. Francisco (Rutland, Vt.), A. F. Mason (Boston), J. A. Seely (New York), H. K. Thurber (New York). The semi-annual meeting next August will be held at Cape May, N.J.

During the four days of the convention there was an extensive collection of electric apparatus on exhibition in Casino Hall, near the headquarters of the association. The hall was brilliantly illuminated by both arc and incandescent lights, and the attendance was good. Electric motors of various sizes were exhibited by the Sprague, the Crocker-Wheeler, and the C. & C. motor companies of this city, the Elektron Company of Brooklyn, the Detroit Motor Company of Detroit, the Baxter Company of Bal-

timore, the Eddy Company of Windsor, Conn., the Jenney Company of Indianapolis, and the Rockford Electric Company. Wires for electrical uses were shown by the New York Insulated Wire Company, the Edison Machine Company, the Electrical Supply Company of Chicago, the India-Rubber and Gutta-Percha Company and the Bishop Gutta-Percha Company, the Ansonia Brass and Copper Company, and the Okonite Company. There was also a fine display of Grimshaw wire. Carbons were exhibited by the Standard and the National carbon companies of Cleveland, conduits for inside electric wiring were shown by the Interior Conduit and Insulation Company of this city, and an interesting exhibit of the new Edison-Lalande batteries was made by the Edison Manufacturing Company of Newark. The elements of this new battery are zinc, a caustic-potash solution, and oxide of copper, the latter being made up in the form of a plate and clamped in a copper frame. The zinc plates are suspended from a binding-post resting on the cover and hanging on either side of the oxide plate. The caustic potash is furnished in shape of sticks, two sticks accompanying each cell. These sticks are placed on either side of the zinc, and the cell is filled with water within an inch of the top, a thin layer of oil being then poured over the top of the water in order to prevent formation of creeping salts. The internal resistance of the cell is only .025 of an ohm. The electro-motive force on open circuit is about one volt, .8 of a volt on light closed-circuit work, and about .7 of a volt on heavy closed-circuit work.

## THE FISHERIES OF NEW ZEALAND.

THE colony of New Zealand is now celebrating its jubilee—the jubilee of its separation from the parent colony of New South Wales — by a series of demonstrations at Auckland, its chief northern town, and by an intercolonial exhibition at Dunedin, the southern metropolis. The latter town is barely forty-two years old, its first settlers having landed from Scotland in March, 1848. It is therefore all the more remarkable to find it now holding an exhibition which, alike by its size, excellence of character, and the illustrative nature of its exhibits, is attracting attention throughout Australasia and Polynesia.

The island colony has hitherto developed only two of her natural sources of wealth; namely, her mines and her agriculture (including pastoral resources under this head). Both, but especially the former, are still capable of great extension and improvement. The third great source to which we desire to draw attention at present is that of her fisheries. These are still almost totally undeveloped, but in time to come they will certainly occupy a very important position. In the Dunedin exhibition there is a very fine display of the mineral, agricultural, and pastoral wealth of the colony, while the fisheries are almost unrepresented. There are no doubt many hundreds of individuals dependent on the industry for their daily bread; but, while the amount of capital invested in agriculture and mines amounts to millions of dollars, that engaged in the fisheries can only be counted by thousands. The promoters of the exhibition obtained almost no response from those occupied in the fishing industry, few of them being able, or finding it to their advantage, to figure as exhibiters. As population increases and means of transit are improved, this state of affairs gives promise of being altered.

A glance at a map of Australasia shows, that while Australia has a great area of land as compared to her coast-line, New Zealand, on the other hand, reverses these conditions. Her coast-line extends to about 5,300 miles, and is indented by numerous deep bays, fiords, and estuaries. At all seasons of the year the seas round her coasts literally swarm with fish, most of them of excellent quality, and many very suitable for canning or curing. In past days New Zealand was noted for her whale and seal fisheries, and American vessels reaped a very considerable share of the maritime harvest; but indiscriminate fishing has nearly exterminated these animals in the local waters, and the enterprise now rarely proves remunerative.

Hitherto very little organized effort has been put forth to develop the fishing industry; but very recently the freezing of fish for the Melbourne and Sydney markets, and the sending over of fresh fish in ice, are both being tried with great promise of success. The appliances in use are still very primitive, small open boats with seine fishing-nets being used in most parts. Only in a few localities are there trawlers or well-boats. Therefore the fishing is limited to inshore work, and is largely conditioned by the weather. Very little is known of the ocean-currents and of their variations of temperature; yet, from what little has hitherto been learned of the distribution of the various species of fish, the latter seems to depend to a considerable extent upon the former. Still less is known as to the development and life-history of the fish themselves. When it is remembered that important questions of this nature have only of very late years received attention from the scientific men and the governments of the oldest and wealthiest countries, it is not to be wondered at if the government of one of the youngest communities of the world has not yet found time or means to do any thing in this direction. The Marine Department has done a little, by way of commencement, in obtaining regular records from the lighthouse-keepers round the coast; but as none of these men are trained observers, and many of them are totally ignorant of the subject, the results, except in a few instances, have not been satisfactory.

The trade returns of the colony give no information as to the value of the fish taken for home consumption, but the export and import returns show that the local supply is still barely equal to the demand. During the six years ending 1885, the colony imported fish (dried, pickled, salted, potted, and preserved) to the value of £252,000, on which the government levied £31,887 as duty. During the same period the export only reached £3,031. In 1888 the imports were as follows: dried, pickled, and salted fish, to the value of £6,006, chiefly from Great Britain; and potted and preserved fish, to the value of £22,361, from Great Britain and the west coast of the United States. On these two items the government realized a duty of £6,062. The value of fish exported during 1888 was £7,450. This is exclusive of the oyster-fishery returns. The export of these mollusks in 1888 was valued at £11,927. These figures show that the outside trade in fish is still in its infancy, and is capable of immense extension. The number of species of marine fish already described as occurring in the coastal waters of New Zealand is close on two hundred; and of this number, over thirty are used as food, and appear in the markets. Many are locally called by names familiar to the settlers who emigrated from Britain, as, for example, cod, haddock, perch, etc.; and the general facies of the fishes of New Zealand is similar to that of the northern hemisphere. More than one-half of the described species are peculiar to the New Zealand seas, but a large percentage, including many pelagic forms, are common to Australasian waters.

One of the most valuable and abundant food-fishes of the colony is the hapuka or groper (*Oligorus gigas*), which is taken with bait all round the coast in from twenty to fifty fathoms. It is a big heavy fish, sometimes nearly six feet long, and varying in weight from forty to one hundred and twenty pounds. Its flesh is very solid and rather coarse, but admirably adapted for curing.

The kahawai (*Arripis salar*) is another abundant fish, especially in the northern portion of the colony. It appears to be migratory, swarming in the warmer seas during the summer months, but avoiding the cold southerly current which washes the southern and south-eastern coasts of the South Island. It is a handsome fish, somewhat resembling a small salmon in appearance, and running from two to seven pounds in weight. It is a capital fish for sport, and takes the fly or spoon-bait readily. The Maoris used to catch it by a bit of pawa-shell (*Haliotis iris*), the bright iridescent hues of which, when drawn rapidly through the water, gave the appearance of a fish swimming quickly. The writer has caught it in the Bay of Islands with such a bait, towing behind a yacht which was scudding along in a half-gale at twelve knots an hour. The

kahawai appears very commonly in the markets, but its flesh is rather dry.

The snapper (*Pagrus unicolor*) is also very abundant, and is one of the best edible fishes in these seas. It is taken up to thirty inches in length, and, though commonly from five to ten pounds, is not infrequently twenty-five pounds in weight. It may be taken by bait, and is a grand fish for sport, but it is commonly caught in seine-nets, in which enormous hauls, weighing several tons, are sometimes taken. Two species of *Latris*, known respectively as trumpeter and moki, are common round the coast. The first is always taken by bait, and the latter only by seine-nets or trawls. They are deep and compressed in form, and range up to twenty or thirty pounds in weight, though often brought to market when only weighing two or three pounds. They are two of the best curing fishes in the colony.

The fish most valued for its gastronomic qualities is the frost-fish (*Lepidopus caudatus*), which is very similar to if not identical with an Atlantic species. Indeed, it is one of the most remarkable features of the fish fauna of the south temperate zone that it resembles in general features that of the north temperate zone, from which it is separated by a totally dissimilar tropical fauna. The frost-fish is a long, narrow, silvery fish, which is apparently never taken either in nets or by bait, but gets stranded on sandy beaches, especially after cold frosty nights: hence its popular name. Numerous theories have been advanced as to the cause of its coming ashore, but no satisfactory explanation has yet been given. Numerous papers on the subject are to be found in the volumes of the "New Zealand Institute Transactions" and in the *New Zealand Journal of Science*, but the subject has not been cleared up. The fish commands a ready sale at a high price, — often as much as half a crown per pound,—and hence is never cured.

Another important pelagic species is the voracious barracouta (*Thyrsites atun*), which appears in enormous shoals about October, and remains on the coast for seven or eight months. It is a common South-East Australian and Tasmanian fish. It is a long narrow fish, bluish-white in color, usually from thirty to thirty-six inches in length, and weighing five or six pounds. It flashes through the water like a knife, and, though it takes bait readily, is not a pleasant creature to hook, as its formidable teeth will cut through any line. Sometimes when half a dozen lines are out from a boat for cod, a barracouta will seize one of the hooks, and, dashing off at a great pace, will in half a minute kink all the lines into an almost inextricable tangle. The usual mode of capture is very simple and interesting. The writer sat on the cliffs at Otago Heads on a summer's morning, watching the fishermen in the still water down below filling their boats. The bait used consists of a piece of red-cedar wood with a bent nail driven through it near one end. This is fastened to a couple of feet of stout cord, which again is attached to the end of a short strong rod. As soon as a shoal is observed to be passing, the oars are unshipped, and each of the two men in the boat, seizing his rod, begins to whisk it round and round in the water. The fish dash at the bait, and are rapidly jerked into the boat, several being often caught in the space of a minute. In perhaps two or three minutes the shoal is past, and the boat is again pulled about till another shoal is met with. The flesh of the barracouta is firm and white. It is especially palatable when smoked, and in this state is exported to a considerable extent to New South Wales and Victoria.

The only true cod (*Gadus Australis*) found in New Zealand waters is called locally the haddock, and is not common. The red cod (*Lotella bacchus*), on the other hand, is extremely abundant, and is also an excellent fish for curing. Its usual weight is from four to five pounds, though it is taken up to ten pounds. Another equally good fish is the representative of the northern fish of the same name,—the ling (*Genypterus blacodes*). This is very common in the southern part of the colony. The so-called rock-cod or blue cod (*Percis colias*), which belongs to a totally different family of fishes from the *Gadidae*, is abundant in all rocky parts of the coast.

The gray mullet (*Mugil perusii*) is met with in enormous quantities in the northern part of the colony, and especially in tidal estuaries. It is the richest of all New Zealand fishes, and is now being extensively canned as well as cured for export in the Auckland and Kaipara harbors. According to Sir James Hector, the Maoris frequently catch this fish on still moonlight nights by paddling their canoes close to the banks of the streams. The fish are startled by the beat of the paddle, and, leaping up, fall into the canoe. The fishermen take them in large seine-nets, as many as two thousand fish at a time having been recorded; and, as each fish weighs from one to four pounds, it sometimes happens that the nets tear with the weight of the haul. The sea mullet (*Agonostoma forsteri*), which is very abundant round the coasts, is a much smaller fish, and not so rich in quality. It is usually caught in all the harbors by persons fishing from the jetties. This fish is sometimes called the herring in popular parlance, but a fish (*Chanos salmoneus*) more closely resembling the true herring is taken occasionally by the trawlers; and, when this mode of fishing is more commonly resorted to, it will no doubt be a common fish in the market.

The true pilchard or sardine (*Clupea sagax*) occurs in enormous quantities round the coasts. Its capture and curing are made a specialty in Queen Charlotte and Pelorus Sounds, and the cured fish is known in the colony as the Pictou herring. An anchovy (*Engraulis encrasicholus*, var. *Antipodum*) has also been taken in the Thames estuary, but not yet in any quantity.

Other fishes common in the local markets are horse mackerel or scad (*Trachurus trachurus*); trevally (*Caranx georgianus*); king-fish (*Seriola lalandii*); John Dory (*Zeus faber*); mackerel (*Scomber australasicus*); gurnard (*Trigla kumu*), called by the local name of "Jack Stuart" in the southern part of the colony; gar-fish (*Hemiramphus intermedius*); butter-fish (*Coridodax pullus*), which is commonly called kelp-fish because usually found among the seaweed fringing inshore rocks and reefs; and the skate (*Raja nasuta*).

A very fine flounder (*Rhombosolea monopus*) is common in all the shallow estuaries, bays, and coastal lagoons. It is the fish most commonly sold in the markets the whole year round, and is certainly very good eating. A sole (*Peltorhamphus novæ-zealandiæ*) and a sole-like flounder (*Rhombosolea leporina*), commonly known as "yellow-belly," are also frequently caught.

Reference has been made in previous numbers of *Science* to the great success which has attended acclimatization efforts in the fresh waters of the colony. Most of the rivers and lakes now teem with trout of several kinds, including the beautiful American brook-trout (*Salmo fontinalis*). Salmon (*S. salar*), perch, tench, and cat-fish are increasing in various parts. Already the various acclimatization societies raise a considerable amount of revenue from licenses, and sales of fish and ova, and no doubt every year the value of the inland fishery will increase. The great experiment, that of the complete acclimatization of the salmon, has not yet been accomplished, but breeding-fish are now to be found in several ponds, so that the supply of ova is assured.

Outside of fishes proper, there are only two species which attract much notice on account of their economic importance: these are crayfish and oysters. The former (*Palinurus*) occurs on all the rocky parts of the coast in great numbers, and is usually taken in a baited ring-net. It is the only representative of the European lobster in these seas. There are no large edible crabs, like those of the northern hemisphere. Shrimps (*Crangon*) and prawns (*Palæmon*, etc.) are hardly ever taken for food, though common enough in places. Oysters are of two kinds, — small rock oysters, which are found all round the coasts; and the mud oyster, of which the most valuable fisheries occur in Stewart Island. The latter kind are very large in size, and fine in quality, and make a formidable mouthful. The quantity dredged has increased so much of late years, that, if not looked after, the beds will soon be exhausted. The export only dates from 1879, when £12 was the declared value. The value has steadily increased each year, standing at £12,000 for 1888. The consumption in the colony must have been very

large, and the low retail price—threepence per dozen—shows how great the take has been.

It is clear, from the mere enumeration of the species named here, that there is great variety in the fish fauna of these islands; and, when the testimony of observers in all parts of the colony as to their immense numbers is taken into account, it is certain that from her fisheries New Zealand will yet reap an immense harvest.

## BOOK-REVIEWS.

*A Popular Treatise on the Winds: Comprising the General Motions of the Atmosphere, Monsoons, Cyclones, Tornadoes, Waterspouts, Hail-Storms, etc.* By WILLIAM FERREL, M.A., Ph.D. New York, Wiley. 8°.

THOSE of us who, about to reach the twoscore prime of middle age, nevertheless feel a little hurt at the respect shown for our advanced years by a younger generation who call us old, may take comfort on realizing that the science of meteorology has been made over again by a man whose labors upon it began only when he had reached our measure of life. William Ferrel was born in 1817, a farmer's boy in Pennsylvania. He grew up in Virginia, dividing his time between the field and the rough country schoolhouse. A love for mathematics then led him into teaching, and afterwards to our Nautical Almanac Office. In 1856, at the age of thirty-nine, Maury's facts made him so dissatisfied with Maury's impossible theory of the winds, that, at the solicitation of a friend, he wrote an outline of what seemed to him a truer conception of the general circulation of the atmosphere; and with this essay the new school of mathematical meteorology began. A few years ago the appearance of Ferrel's "Recent Advances in Meteorology" gave occasion to state the outline of his theory,[1] in comparison with others generally in vogue. Another volume now allows another reference to this attractive subject.

This "Popular Treatise on the Winds" embodies the substance of a series of forty lectures delivered by Ferrel before a class of army officers of the Signal Service in February and March, 1886. It is now much expanded by deliberate statement of the fundamental principles of atmospheric rest and motion, and is illustrated by abundant citation of pertinent observations and records. The book is too serious, too severely argumentative, for general reading; but it will for a long time have no equal in our language as a volume to which teacher and student may make safe reference in the search for the solution of difficulties. The plan of the book may be judged by a brief review of its contents. It opens with preliminary chapters on the constitution and nature of the atmosphere, and on the motions of bodies relative to the earth's surface; the latter being a subject which Ferrel has made his own, and without which no safe step can be taken in the discussion of atmospheric movements. The third chapter discusses the theoretical circulation of an atmosphere lying on a rotating globe, and heated around the equator, deducing therefrom certain critical consequences, and confronting them with the facts as ascertained by observation. He must indeed be wanting in the scientific turn of mind who does not find mental entertainment in the logical order of investigation here traced out, quite apart from its bearing on the special science to which the book is devoted. Next follow a chapter on the climatic influences of the general circulation of the winds, in the production of wet and dry zones and of wet and dry mountain slopes, and in the determination of equable and variable temperatures on the west and east sides of continents, and another chapter on the monsoons, littoral breezes, and mountain and valley winds, by which the general terrestrial circulation is more or less broken up. Thus the first half of the book is occupied. The second half discusses those great travelling whirls known as cyclones, and the more local tornadoes and thunder-storms, on all of which the impress of Ferrel's methods is most clearly marked.

Through all this there runs a single theme. Some fact of occurrence calls for explanation. A fit explanation is devised, strictly in accord with a full knowledge of physical law, and its consequences are then deduced as minutely as may be. These are matched with the facts, and the validity of the theory is measured by the degree of correspondence then detected. No one can read such a work as this without feeling a distinct intellectual gain from the keen vigor of its methods.

There is one feature in Ferrel's theory of the atmospheric circulation that does not seem to be generally appreciated. We may perhaps best approach it through its misapprehension by certain commentators. Professor Supan, editor of *Petermann's Mitteilungen*, whose extended reviews give us the best means of keeping abreast with the advance of geography in all its branches, referred four years ago to Ferrel's theory in a notice of Sprung's

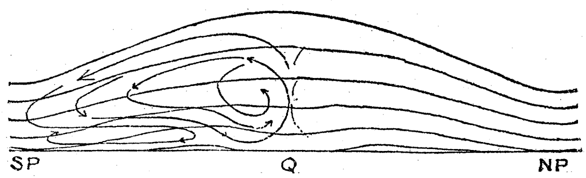



FIG. 1.

"Lehrbuch der Meteorologie." He said in effect that the distribution of atmospheric pressure was the control, not the result, of atmospheric motion; and that, as there is low pressure at the poles and high pressure at the tropics, the hypothetical return current from poles to equator cannot exist, for it would have to move against the barometric gradients.[1] The same question is asked by M. Léon Teisserenc de Bort, one of the specialists of the Bureau Central Météorologique de France. In an essay on the general circulation of the atmosphere,[2] this author says, "Mr. Ferrel does not explain the cause of the gradient that is directed toward the equator, and that is necessary for the return current from pole to equator, which he places at a middle altitude in the atmosphere. This gradient is the more difficult to explain, inasmuch as the pressure at sea-level decreases towards the pole, and as a similar decrease must exist aloft to determine the flow of the

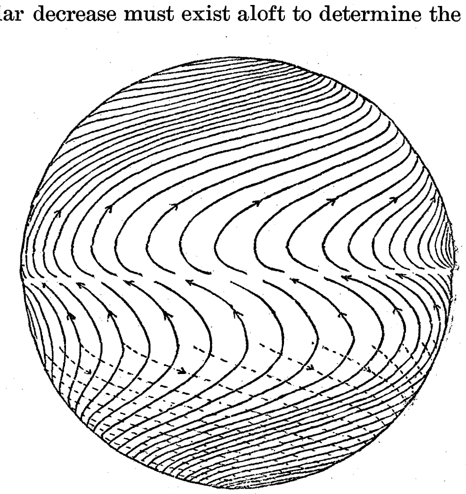


FIG. 2.

upper current from the equator." These criticisms appear reasonable enough at first sight, but this is because they fail to apprehend one of the essential points in Ferrel's theory. The case may be stated in brief as follows:—

Given a uniform distribution of temperature in the atmosphere, its imaginary isobaric surfaces will stand level, essentially equidistant. Given two adjacent regions, one maintained at a higher temperature than the other, the isobaric surfaces can no longer be level or parallel. A convectional interchanging motion will be established, as a consequence of which there will come to be a slight excess of pressure in the colder region. The isobaric surfaces, not parallel, but diverging from the region of cold and compressed air to the region of warm and expanded

[1] Science, iv. 1887.

[1] Petermann's Mitteilungen, Lit. Bericht., 1886.
[2] Ann. Bur. Centr. Mét., 1885, part. iv. Mét. Générale.

air, are no longer level: they are deformed into slanting positions, and the slant or gradient is directed toward the warm region in the lower atmosphere, and toward the cold region in the upper atmosphere. Thus far every one is willing to go: and, if it be desired to try the experiment on a class of intelligent scholars, some live interest in the question may be aroused by asking how far they are individually ready to assert that this simple abstract theory is applicable to the case of the earth; the warm region being the equator, where the mean annual pressure must therefore be low, and the cold region being either pole, where the pressure must be correspondingly high. No more salutory lesson can be given in the danger of the purely deductive method in the hands of others than the masters of a subject, for the high pressure that is confidently expected at the poles does not exist. The pressure there is lower than at the equator. The contradiction of theoretical deduction by well-ascertained fact is of the flattest kind, and the scholar may fairly be excused if for a time he loses faith in a theory that has led him into so blundering an expectation. But when he looks further, and finds that there is a belt of lower pressure at the equator than at the tropics, and that this belt migrates with the seasonal shifts of the heat equator, and that the continents unload their share of atmosphere somewhat in their summer season, it becomes apparent that the theory must be wrong chiefly by omission; and it may be readily shown that the omitted consideration is the effect of the earth's rotation. There are very few men in the world who have for themselves avoided this omission; and of these few, Professor Ferrel is the only one who has given the complete theory the full consideration that it deserves.

The fact that the interchanging convectional circulation of the atmosphere between the equator and the poles takes place upon an earth that rotates on its axis, requires the development of great eastward spiral polar whirls, and the centrifugal force of these whirls greatly deforms the simple arrangement of the isobaric surfaces that would be produced by differences of temperature alone; so greatly, indeed, that the theoretical high pressure of the poles is reversed to actual low pressure. In consequence of this, the gradients of nearly all the atmosphere are directed polewards, the only gradients that lead to the equator being in the lower atmosphere within the tropics, where we have the trade-winds. This may appear more clearly in Fig. 1, which represents a vertical meridional section of the atmosphere, greatly magnified vertically, from pole across the equator to pole; the meridian line being, for simplicity, straightened out from its true semicircular curve. The pressures at the surface are known by observation, being, on the average, about 29.9 at the equator, 30.1 a little outside of the tropics, and perhaps 29.0 at the poles. Remembering that the successive isobaric surfaces diverge from the cold polar regions towards the warm equatorial belt, a number of higher and higher surfaces may be drawn in section, and the prevailing poleward slope of the gradient is then made apparent.

Now, the question asked by Supan and Teisserenc de Bort is practically this: "How does the air, which flows toward the poles on the steep gradient of the upper current, manage to return to the equator against the poleward gradients of the lower levels?" This is as if they asked, "How does the ocean stand thirteen miles higher (i.e., farther from the earth's centre) at the equator than at the poles, instead of at once rushing tumultuously poleward?"

The low pressure at the poles is the indirect product of the initial meridional convectional circulation between poles and equator, and the deformation of the simple convectional gradients thus introduced can never go so far as to stop the convectional motion by preventing the return of the lower current to the equator. The great velocity and consequent great centrifugal force attained by the upper current, as it swings around the pole on the steep upper gradients, enable it to run obliquely against the weaker lower gradients as soon as it encounters them in the descending portion of its convectional circuit. That is the essence of the whole affair, though it may be stated in different ways, from words to formulæ. Perhaps a simpler way of putting it is this. The difficulty comes from thinking that the lower isobaric surfaces slope toward the pole. But it must be remembered that slopes and levels are determined by the local direction of gravity, not by distance from the earth's centre; that the local direction of gravity is determined by the local value of the centrifugal force arising from axial rotation, and the velocity of axial rotation depends on whether the body that is under discussion goes around the axis once in twenty-four hours, as we do who live on the earth's surface, or in a decidedly less time, as the eastward winds do. If the earth had no rotation, its present level surfaces would be called poleward slopes. The winds which move eastward must regard the sea-level as an equatorward slope; and the fast winds of the great eastward whirls around the poles must regard even the lower gradients of the atmosphere as slopes directed toward the equator, and not toward the pole. It is only the lower winds, whose velocity is weakened by surface friction, that have the same opinion of the lower gradients as we have, and obey them by moving obliquely toward the pole. This is not a matter that needs mathematical statement for its demonstration. The rational conception of the process, on which the validity of any mathematical treatment must be based, is sufficient to demonstrate that the isobaric surfaces, whose arrangement is determined simply by differences of temperature, cannot agree in position with those which are, as it were, deformed by the introduction of the deflective forces that arise from the earth's rotation; and to demonstrate, further, that the deformation thus introduced can never go so far as absolutely to stop, although it may greatly retard, the meridional or convectional components of motion, on whose persistence all the other motions depend. The reader of the "Popular Treatise on the Winds" can come to no other conclusion than that the essential nature of the circulation of the winds is such as is here outlined; and the doubts raised by Supan and others will then not be regarded as objections to Ferrel's theory.

The actual circulation of the winds over continents and oceans is greatly complicated by seasonal and topographic influences, as well as by the presence of numerous cyclonic storms, marching in continuous procession around either pole. But the ideal planetary circulation is relatively simple; and, as the graphic illustration of its course is seldom given in more than highly diagrammatic forms, we venture to introduce here a more carefully drawn view of it, the upper winds being exhibited in the northern hemisphere, and the hypothetical return current of middle elevation being drawn on the southern, while the surface winds are in dotted lines beneath. There is much that is hypothetical in this; but it is as a whole well borne out by actual observation. One of the questions that is still open is the latitude at which the upper poleward overflow from the equator has a directly poleward motion. The latitude certainly varies with the altitude, but it does not appear to be more than ten degrees north or south of the equator: for on a poleward gradient, and with a right-hand deflection, both of which are undoubted, the upper overflow cannot long maintain the westward component of motion that it possesses above the equator; and, as a matter of fact, the oblique pole-eastward motion of the overflow has often been observed in the drifting of clouds and in the wind on mountain-tops in the so-called "anti-trade."

The reader must not imagine that all of Professor Ferrel's book is occupied with theoretical discussions. The citation of appropriate facts is plentiful and well selected; quotations are made at length from various sources; and although the winds are, by the title of the work, its main theme, one needs but small acquaintance with meteorology to know that nearly all of the science may be fairly presented under this heading. It is most natural that a course in meteorology should begin and end with a discussion of the circulation of the winds; for pretty much every thing meteorological is, like the deformation of the polar gradients, more or less closely a sequence of the motion of the atmosphere. When the educational value of the study of meteorology is more widely appreciated, as it must be when more of our teachers are familiar with such works as this one of Ferrel's, it may come to be true, as an eminent Scottish meteorologist some twenty years ago imagined it was already at that time, that "in the schools of the United States of America,

meteorological observations and the keeping of meteorological registers form a part of the common education of the people."

W. M. D.

## NOTES AND NEWS.

AT the Franklin Institute, Philadelphia, Monday evening, Feb. 17, Mr. George F. Kunz of New York lectured on precious stones, showing lantern illustrations of the Paris Exposition.

— The next meeting of the American Branch of the Society for Psychical Research will be held at the rooms of the Boston Society of Natural History, corner of Berkeley and Boylston Streets on Tuesday, March 4, at 8 P.M. Professor William James will preside. An abridgment of papers by Mr. Frank Podmore and Mr. F. W. H. Myers, on "Phantasms of the Dead," will be read by the secretary. No admittance except by ticket.

— The New York Mineralogical Club made an excursion on Feb. 22 to Philadelphia, to visit one of the principal mineral localities and some important collections. Leaving by the 8 A.M. express, they reached Broad Street Station at 10.10. Here the party was met by representatives of the Mineralogical Section of the Philadelphia Academy. Thence, under the guidance of Mr. Theodore D. Rand, they went by rail to the Soapstone Quarry, on the Schuylkill, crossing exposures in the vicinity of the quarry, of most of the rocks of Philadelphia. Returning to Broad Street between 1 and 2 P.M., they visited the Academy of Natural Sciences during the afternoon, and the celebrated cabinet of Mr. Clarence S. Bement. The return to New York was by the train leaving Broad Street at 8.30 P.M.

— In the "Third Annual Report of the Henry Draper Memorial," attention is called to the fact that the K line in the spectrum of $\zeta$ Ursæ Majoris occasionally appears double. The spectrum of this star has been photographed at the Harvard College Observatory on seventy nights, and a careful study of the results has been made by Miss A. C. Maury, a niece of Dr. Draper. The K line is clearly seen to be double in the photographs taken on March 29, 1887, on May 17, 1889, and on Aug. 27 and 28, 1889. An examination of all the plates leads to the belief that the line is double at intervals of fifty-two days, beginning March 27, 1887, and that for several days before and after these dates it presents a hazy appearance. The doubling of the line was predicted for Oct. 18, 1889, but only partially verified. The star was, however, low, and only three prisms could be used, while the usual number was four. The only satisfactory explanation of this phenomenon as yet proposed is that the brighter component of this star is itself a double star, having components nearly equal in brightness, and too close to have been separated as yet visually; also that the time of revolution of the system is one hundred and four days. When one component is approaching the earth, all the lines in its spectrum will be moved toward the blue end, while all the lines in the spectrum of the other component will be moved by an equal amount in the opposite direction if their masses are equal. Each line will thus be separated into two. The predicted doubling of the lines of $\zeta$ Ursæ Majoris on Dec. 8 was confirmed on that day by each of three photographs. Two more stars have been found showing a similar periodicity.

— The *Engineer* of Jan. 31 contains a leading article on color-blind engine-drivers, and it is interesting to note what the leading technical journal has to say on the subject: "We do not say that no accident was ever brought about by the inability of a driver to distinguish between a green light and a red one, but we can say that nothing of such an accident is to be met with in the Board of Trade Reports." Our contemporary is of opinion that the testing of the sight of locomotive men should be made under working conditions, i.e., with actual signal lights.

— We learn from *Nature* of Feb. 6 that a paper on mortality from snake-bite in the district of Ratnagherry was read before the Bombay Natural History Society by Mr. Vidal, of the Bombay Civil Service. Many of the deaths in that district are, he says, due to a small and insignificant-looking snake, called "foorsa" by the natives. It is a viper rarely more than a foot long, and is so sluggish that it does not move out of the way till trodden on. Thus it is much more dangerous than the stronger and fiercer cobra.

— A new and very simple method of synthesizing indigo has been discovered by Dr. Flimm of Darmstadt (*Ber. deut. chem. Ges.*, No. 1, 1890, p. 57). In studying the action of caustic alkalies upon the monobromine derivative of acetanilide, $C_6H_5.NH.CO.CH_2Br$, a solid melting at 131.5°, it was found, that, when this substance was fused with caustic potash, a product was obtained which at once gave an indigo-blue color on the addition of water, and quite a considerable quantity of a blue solid resembling indigo separated out. The best mode of carrying out the operation, according to *Nature*, is described by Dr. Flimm as follows: "The monobromacetanilide is carefully mixed with dry caustic potash in a mortar, and the mixture introduced into a retort and heated rapidly until a homogeneous reddish-brown melt is obtained. This is subsequently dissolved in water, and a little ammonia or ammonium-chloride solution added, when the liquid immediately becomes colored green, which color rapidly changes into a dark blue; and in a short time the blue coloring-matter is for the most part deposited upon the bottom of the vessel in which the operation is performed. The fused mass may also conveniently be dissolved in dilute hydrochloric acid, and a little ferric chloride added, when the formation of indigo takes place immediately. The collected blue coloring-matter may be readily obtained pure by washing first with dilute hydrochloric acid, and afterwards with alcohol." That this blue substance was really common indigo was proved by the fact that it yielded several of the most characteristic reactions of indigotin, such as solubility in aniline, paraffine, and chloroform; its sublimation; and the formation of sulphonic acids, which gave similar changes of color with nitric acid to those of indigotin. The final proof was afforded by its reduction to indigo white, and re-oxidation to indigo blue by exposure to air. Moreover, the absorption spectrum of the coloring-matter was found to be identical with the well-known absorption spectrum of indigo: hence there can be no doubt that indigo is really formed by this very simple process.

— A recent telegram from Tashkent, says *Nature*, announced that Col. Pevtsoff and M. Roborovsky had discovered a convenient pass to the north-western part of Thibet, from Nia, and had amounted to the great tableland. The plateau has there an altitude of 12,000 feet above the sea, and the country round is desolate and uninhabited, while towards the south the plateau is well watered and wooded. The Tashkent telegram is so expressed that it might be supposed to mean that two separate passes had been discoverd by the two explorers. But the news received from the expedition at St. Petersburg on Dec. 26, and dated Oct. 27, shows that both explorers proposed to leave the oasis of Keria (100 miles to the east of Khotan) on the next day, for Nia (65 miles farther east), and there to search for a passage across the border-ridge which received from Prjevalsky the name of the "Russian Ridge." This immense snow-clad chain separates the deserts of eastern Turkestan from the trapezoidal space, the interior of which is quite unknown yet, and which is bordered by the "Russian Ridge" and the Altyn-tagh, in the north-west; the ridges of Tsaidam and those named by Prjevalsky "Columbus" and "Marco-Polo," in the north-east; the highlands (explored by Prjevalsky in 1879–80) at the sources of the Blue River, in the south-east; and a long, yet unnamed ridge, which seems to be a prolongation of the Tan-la, in the south-west. The pass leading to that plateau from Nia, and now discovered by the Russian expedition, is situated some 80 miles to the east of the well-known pass across the Kuen-lun Mountains, which leads from southern Khotan to Lake Yashi-kul. M. Roborovsky's intention is evidently next to move up the Tchertchen River, and to endeavor to reach the ridges "Moscow" and "Lake Unfreezing" (11,700 feet high), which were visited by Prjevalsky from the east during his last journey. Having succeeded in finding a pass to Thibet in the south of Nia, Col. Pevtsoff proposes, as soon as the spring comes, to proceed himself by this pass to the tableland, while M. Roborovsky probably will be despatched

to explore the same border-ridge farther east, in the south of Tchertchen.

—The Western Union Telegraph Company has lately put in operation in Chicago a new plant of dynamo-machines to take the place of the gravity-batteries which have been used in the business of the company. The plant consists of eighteen dynamos of the Edison pattern, arranged in three gangs of six each. Two gangs are in constant use, the third held as reserve. Each gang is driven, independently, by a Sprague motor, power being furnished from the central station of the Edison Light and Power Company. The current for the Western Union lines radiating from Chicago has been furnished heretofore by gravity-batteries, aggregating something over thirty thousand cells, at a cost of about one dollar and twenty-five cents per annum for each cell. The reduction in cost of maintenance of storage space, and the improvement in efficiency, are very great. The Chicago office is the only telegraph station in this country where the gravity-battery has been entirely superseded by dynamo-machines, and marks a new departure in telegraphy. The plant and its connnections embrace many features and applications novel and interesting. The plans, designs, and calculations were worked out by Mr. L. L. Summers, one of the electricians of the Western Union Company, and under whose direct supervision the changes have been made, and whose success establishes his reputation as a competent scientific electrician.

—The first shipment of Java cinchona-bark in commercial quantities was made on Sept. 28, 1869, when fourteen packages, weighing altogether nine hundred pounds, left the island for Holland. The consignment was in the hands of the Netherlands Trading Company, and that organization called in two professors to give an opinion on the trial shipment. Their report was very favorable, says *Indische Merkur*, and the bulk of the shipment was sold privately to manufacturers and dealers. Five of the purchasers afterwards also gave their opinions of the bark; but all agree, that, owing to its immaturity and insufficient alkaloid contents, the cinchona was unfit for manufacturing purposes, although it would answer admirably for druggists' use. In 1870 the Java exports amounted to 41 bales and 28 cases, and on Oct. 20 of that year the first public auction of 876 kilos took place in Amsterdam. Up to 1883, one or two public sales were held every year. Last year there were ten, and for 1890 the same number is announced again. The first private planter to commence cinchona-growing in Java was Mr. K. F. Holle, in 1866; but not until about eight years later, when the first consignments of the rich Ledger barks had been shipped to Europe and realized enormously high prices, did private planters commence to pay special attention to the article. At first the intention of the shippers appears to have been to send all the Java bark for sale to London, where a market already existed for the article; but the Netherlands Trading Company determined to create a centre in Amsterdam, and the importance which that market has now acquired demonstrates the wisdom of their decision. In 1878, when it had been shown beyond doubt that the most valuable cinchona alkaloids were found principally in the outer bark layers, the then director of the Java Government plantations, Mr. Moens, decided to adopt the system of scraping the older Ledger trees; but after some seasons the scraping was found to be injurious to the trees, and since 1886 this method of harvesting has been abandoned in the government plantations, although it is still followed by a few private planters. At first all barks were cut to the uniform size of twenty centimetres (about eight inches), and brought to market in quills, all bark which could not be harvested in this manner being crushed to a coarse powder. The trade in the beginning offered considerable opposition to the sale of this powdered bark, as it was believed to facilitate sophistication, and also on the alleged ground that the powdered bark lost some of its alkaloidal richness by keeping. At present, however, the system of crushing bark has become universal in Java, and at the Amsterdam auctions nearly all the manufacturing barks are now offered in that condition, and the pharmaceutical barks in quills. Since 1874 it has been customary, according to the *Oil, Paint, and Drug Reporter*, to sort the Java quill bark into two classes, according to length.

—Possibly no food-product was more extensively shown at the Paris Exhibition than olives and olive-oil. In the French official catalogue 606 exhibiters of olive-oil are specially named, besides numerous collective exhibits, and many others which are included under the general term "comestible" or edible oils: 448 of these exhibiters are from Portugal, 128 from California, and only 12 from France. One French exhibit, however, is made by 67 associated producers. The Mediterranean has from time immemorial been the seat of the olive-culture, and, according to the *Journal of the Society of Arts*, Spain has about 3,000,000 acres under olives; Italy, 2,250,000; and France, about 330,000. Tunis has over 4,000,000 trees, Algeria 3,000,000, Nice 1,000,000, where olive-oil forms four-fifths of the agricultural produce, and Syria several million. The number of trees in other countries is unknown. Tuscany first exported olive-oil: hence its old name, "Florence oil." Forty-five distinct species of the olive-tree have been described, and in countries where it is indigenous the tree sometimes reaches a height of sixty feet, with a trunk circumference of twelve feet. Besides the difference in the nature of the wood, foliage, and habit of growth, there are large olives and small olives, pointed, oval, round, and curved fruit, and of all colors, ranging from white to black and from green to red. The flavor of the fruit is mild, sharp, or bitter, and according to the variety there is obtained sweet-oil, light-colored and of exquisite flavor, up to dark green, thick, and of a bitter taste, strong and very unpleasant to the taste.

—For the last forty years attention has been paid to the production of smokeless explosives, and in no country with more marked success than in England; and this is due mainly to the initiative and energy of Sir Frederic Abel. He is to-day looked up to, says *Engineering*, as a great authority on the subject of explosives; and it is not surprising, then, to find that the mere announcement that he was to give a "Friday evening" discourse brought to the theatre of the Royal Institution, London, not only a large number of those who have its *entrée*, but also knots of gentlemen from abroad who were eager to hear the very latest about smokeless explosives, and the probable effect of their introduction into naval and military warfare. Sir Fredric Abel spoke of the early efforts made in Germany in France to produce smokeless explosives, and dwelt with emphasis upon the superior intrinsic qualities of gun-cotton, pointing out at the same time that its application as a safe and reliable propulsive agent for military and naval use is still attended by many serious difficulties, — difficulties which will be ultimately overcome, and probably in the immediate future. Reference was made to melinite and other French explosives. Despite the secrecy with which their composition is kept, it is pretty certain that the chief element is picric acid; and, as this body is exceedingly unstable, it is probable that but little more will be heard about these much-vaunted destructive explosives. The most successful of contemporary experimenters with high explosives is Mr. Nobel, the inventor of dynamite and other efficient blasting-agents. He appears to have derived from nitro-glycerine and nitro-cotton a material which, when treated with camphor, compares very favorably with gun-cotton as to its ballistic properties, its stability, and uniformity, besides being almost absolutely smokeless. This powder has been tried in small arms in Italy, and reports are current that Mr. Krupp is carrying on experiments with it in guns of various caliber. Sir Frederic Abel corrected an impression that seemed to be spreading; viz., that the new powder would be not only smokeless, but also noiseless. It was shown that there is hardly any noticeable difference between the explosive violence of the new and the black powder. If any thing, the report of the former is sharper and more ringing, as well as of shorter duration. The absence of smoke in the battles of the future will call into requisition military qualities that up to the present have lain dormant.

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CONTENTS:



## RECENT STUDIES IN HYPNOTISM.[1]

### Hypnotization against the Will of the Subject.

WHILE it has been generally admitted that subjects who have been frequently hypnotized lose the power of resisting the customary manipulations of the operator, or, in other words, that the natural suggestion of going to sleep at the sight of the operator and his proceedings is stronger than the auto-suggestion not to yield (just as we may fall asleep, in spite of all effort, at a lecture or social gathering), yet great stress has been laid upon the original consent of the subject to submit to the operation, as well as upon a considerable power of resistance by sheer determination. Dr. Herrero, a Spanish writer on the subject, has recently announced a means of hypnotizing any body and every body, *nolens volens*.

A great number of those classed as non-hypnotizable will succumb, says this authority, if the process be maintained for a sufficient length of time. As this is very trying to the operator, a device may be resorted to by which the subject is forced to gaze continuously at a bright object, the operator re-enforcing the suggestion to sleep. If, however, the subject resist the proceedings, one may bind him, and force him to assume the position necessary for hypnotization. But this drastic process may be dispensed with; for in those cases in which it is necessary, for therapeutic or correctional purposes, to hypnotize a person, Dr. Herrero has another method. It is based upon the discovery that in light chloroformization there is a stage in which the subject obeys suggestions as readily as in hypnotism. This period may at first be brief, but may be prolonged by care and practice. While in this "chloroformic somnambulism," the suggestion is given that in future no such agency will be necessary to hypnotize the subject, in some the suggestion is mâde gradually that they will resist less and less; and so on. While this disposes of those unconsciously resisting hypnotization, does it apply to those opposing it voluntarily? Here is a case in point. A patient showed a morbid fear of hypnotism, regarding it as a satanic art, and absolutely refusing to be hypnotized. It had been attempted over and over again, but in vain. Chloroformization was proposed, to which she consented. The first day it required fifteen grams to bring on the susceptible period, then thirteen, and so on until the patient went to sleep by merely staring at the doctor's fingers, and became a good hypnotic subject. By this means, then, it is proposed to induce a state by the action of drugs from which the transition is easy and certain to ordinary hypnotism. It seems probable that there will be much discussion and experimentation in this novel mode of extending the powers of hypnotism.

[1] Mainly from current numbers of the Revue de l'Hypnotisme.

### Auto-Hypnotism.

By this is meant the power to put one's self to sleep. We do this every night, and persons differ very markedly in the ease and rapidity with which they fall asleep both at night and at other times. Dr. Coste de Lagrave has developed this power to a considerable extent, making himself at once operator and subject in an hypnotic experiment. The best time to experiment is just after awakening. One then attempts to go to sleep again for a short time only. One may wake and go to sleep again three or even five times in an hour. The sleep is light, may be accompanied by dreams, and the sleeper be sub-consciously aware of his condition. When the sleep is still lighter, and self-consciousness is largely present, the auto-hypnotic state has appeared. Dreams may occur, though the dreamer is perfectly conscious that he is dreaming, and may even attempt to direct these dreams. This amounts to auto-suggestion. To enter this state, the author lies down, closes his eyes, tries to sleep, keeping his thoughts fixed on the desired auto-suggestion. Here are a few instances of his success. As the result of a dysentery contracted in Tonkin, he could not walk a mile without extreme fatigue. One evening he gave himself the suggestion not to become tired, and the following day he was able to take a long walk. He suggests good appetite, and suggests away dyspepsia and cold feet, even under the most trying circumstances, such as in the open air on a cold day, and finds that his feet are really warm to the touch. Hallucinations are thus excited. He writes, talks interestingly, all by auto-suggestion. But the process is not without its disadvantages. Fatigue, depression, and sometimes severe headache, are the results. Like all phases of hypnotism, it has its uses and abuses. While this power is thus unusually developed in the cases cited, it undoubtedly exists to a lesser degree in many; and it would not be difficult to find in the habits of all a close analogy to what is here termed "auto-suggestion."

### Retro-active Hallucinations.

This name has been given by Dr. Bernheim to hallucinations suggested back into the experience of the hypnotized subject. He is told that so many days or weeks ago he was a witness of such and such an act. The suggestion is accepted, perhaps additional details are added, and the fictitious event is embodied with the ordinary experiences of life. The case to be here noted is interesting, on account of influencing several at once, some without direct personal suggestion, and on account of being accepted by a person who happened to be sleeping normally. In one of the wards of the hospital, Dr. Bernheim hypnotized eleven patients while one was sleeping normally. He tells one of his subjects, "You see No. 3 seated on a chair. Yesterday he came back intoxicated, sang and shouted through

the halls, struck the keeper, making his nose bleed. You were there." The illusion soon developed; and the subject repeated the whole story, adding that a nurse came with a basin of water to wash off the blood. A neighboring subject was then aroused, and asked what happened yesterday to No. 3. After some hesitation, he repeated the story. And so on with all the others, including one who was sleeping naturally. No. 3 himself admitted that he struck the keeper, but he did not begin the quarrel. None of these patients had ever assisted at such an experiment before. The experiment may not succeed at all times and with all subjects; but it shows, that, when the sleeper has his attention fixed upon the person who is speaking, he hears and accepts every thing. On awakening, he does not recall this of his own accord; but, as soon as a hint is given, he recalls it all, and accepts it as a reality. As a practical outcome of the observation, Dr. Bernheim gives the warning not to tell secrets in the presence of a sleeper.

### Statistics of Cures by Hypnotism.

The methods and purposes of the clinic for the treatment of diseases by hypnotism, founded at Amsterdam by Drs. van Reuterghem and van Eeden, have been noticed before in these columns (*Science*, May 24, 1889). On the occasion of completing the first two years of their experience, they have put together an account of the kind and number of diseases treated, and the amount of success achieved; and these statistics, being comparatively extensive and carefully collected, have good claims to general consideration. There were treated, in all, 414 patients (219 men and 195 women). Of these, only 15 (less than 4 per cent) could not be hypnotized; 217 (53 per cent) entered a light stage of sleep; 135 (32 per cent) entered a deeper stage; and 47 (11 per cent) entered the somnambulic stage, characteristic of the best hypnotic subjects. The ages of the patients were distributed as follows: from 1 to 10 years, 9; from 11 to 20 years, 46; from 21 to 40 years, 203; from 41 to 60 years, 131; from 61 to 80 years, 25. There were 361 of the 414 afflicted with various kinds of nervous troubles, 168 were classed as general neuropathic disorders, 68 as neuralgias and pains, 60 as mental diseases, 40 as hysterical affections, and 29 as organic affections. In general, the effects of the treatment are indicated by the following figures: no effect in 71 cases (20 per cent), a slight or passing improvement in 92 cases (26 per cent), a distinct and permanent improvement in 98 cases (27 per cent), and a cure in 100 cases (28 per cent). The disproportion in the number of nervous and non-nervous cases makes a fair comparison of the results in the two classes impossible. Among the nervous diseases, those classed as neuropathic show a very favorable result, 33 per cent being cured, and 26 per cent permanently benefited. Hysterical and neuralgic affections show nearly as high a percentage, though the absolute numbers are here much smaller. Diseases classed as organic naturally show the very minimum of success in treatment. We have thus no announcement of hypnotism as a panacea curing all diseases, but a fair proportion of success and failure distributed among various disorders in a way that accords with our knowledge of the nature of such diseases. It is only by such impartial and scientifically collected results that the movement can make progress.

## AMONG THE PUBLISHERS.

LAST week's issue of *Garden and Forest* contains an excellent illustration of the famous Waverly Oaks, near Boston, and a figure of *Gladiolus turicensis*, one of the noteworthy additions to garden-plants last year. Mr. Charles Eliot writes instructively of the coast of Maine; and among other contributors to the number are Professor J. B. Smith, Professor W. A. Buckhout, Professor E. S. Goff, Professor J. T. Rothrock, Dr. Udo Dammer, John Thorpe, and Mrs. Schuyler Van Rensselaer.

— The March number of the *New England Magazine* will contain many portraits. In the article on the "Supreme Court of the United States" there will be given likenesses of more than a dozen of the great justices. In an article on "Chautauqua" will be found portraits of Bishop Vincent and Mr. Lewis Miller. "A Successful Woman's Club," "A Strange Dinner-Party," and "An Old New England Country Gentleman," are other illustrated articles in this number.

— To meet the demand for a much greater variety and number of illustrations in the *American Architect*, Messrs. Ticknor & Co. have arranged to more than double the extent of that department, and to add many new features. To give their subscribers a greater amount of illustration, it is necessary to increase the subscription price, but only to those who desire the increased illustration. They therefore continue their regular and imperial editions, but have issued, in addition, an enlarged and more expensive edition, called "the international edition." The international includes all that the imperial contains (that is, the equivalent of 384 pages of photo-lithographic illustration of all sorts, also 40 gelatine and 12 heliochrome plates, and the extra photogravure plate for the year), and adds (A) a large amount of foreign work, received regularly from England, France, and Germany. The apportionment of this new matter is not yet finally settled, but it will amount approximately to over 200 pages of photo-lithographs, and probably 150 gelatine plates, besides a large number of genuine copperplate etchings. To give still further value to this edition, there will be from time to time (B) additional colored prints and (C) real photogravures, — genuine copperplate prints, such as are issued by Messrs. Goupil in Paris by that name. But the feature perhaps the most interesting to the American profession will consist (D) in publishing in this international edition, as far as subscribers will aid, competitive designs submitted in limited, and in some cases in public, competitions. To do this — to provide a journal containing approximately 1,000 page illustrations (besides nearly as many smaller cuts in the text) and (E) an attendant increase in the text of four pages weekly, 200 pages per annum — has required a considerable increase in the subscription price, and it cannot be placed at less than $25 per annum. At the same time, to place it within reach of many to whom so large a single payment might be an inconvenience, quarterly payments at a slightly increased rate may be made when preferred. No subscriptions will be received, however, for less than the full calendar year, as the plans involve contracts in at least three foreign countries, made upon a permanent basis by the year. There has just been issued in the *American Architect* a photogravure from Mr. Axel H. Haig's famous etching, "At the Fountain of St. George." This is commonly called "St. George at Lubeck;" but Mr. Haig writes, "The subject is not to be found at Lubeck at all or in any North German town. The work is a composition, partially founded on a scene in an old Bavarian town, but, being so very much an invention, I cannot give a locality to it."

— "The danger of an ignorant person in seizing an electric wire carrying a strong current is as great as that to which a person ignorant of the ways of snakes would be subjected if he undertook to take the place of the skilled observer . . . accustomed to put his arm into a tall jar containing rattlesnakes and take them out." This extract will show the general drift of an article on "Dangers from Electricity," by John Trowbridge, which appears in the *Atlantic* for March. There is a paper by Charles Worcester Clark on "Woman Suffrage, Pro and Con;" George Parsons Lathrop shows us "The Value of the Corner;" and there is a paper called "Loitering through the Paris Exposition," which tells, among many other things, of all the concerts given at the cafés of the exposition by the various nationalities, — Gypsies, Javanese, Hungarians, and many more. Dr. Holmes is particularly amusing in "Over the Teacups," and seems to wish that people would write less poetry. He closes with some odd verses on the rage for scribbling.

## LETTERS TO THE EDITOR.

### Physical Fields.

I THINK Professor Dolbear misunderstands the motive of my communication relative to physical fields, that appeared in *Science* Jan. 24. It was not so much what I conceived to be misuse of the term "stress," that I wished to call attention

to, but rather what I believed to be a misconception of the nature of certain phenomena which such misuse seemed to imply. Let me see if I can maintain my ground.

If two bodies connected by an elastic medium retain their relative positions, the two may be transported or caused to move in any or all possible ways, and still with all speeds; yet the condition of stress under which this elastic connecting medium exists is not changed at all. If a force be exerted upon one of these bodies, tending to change its position relative to the other, the stress of the elastic connecting medium will be changed; and I do not think it necessary to conceive of a rate of propagation of this modified stress from the one object to the other, for, if the second body were not attached to the first in some way, the force applied to the first could produce no stress whatever in the medium connecting the two. A push on one becomes a pull on the other, but there could be no push on the one without there being an exactly equal and opposite effect upon the other. Has any propagation taken place in this case?

If, again, we have a system of bodies, all of which are connected with each other by elastic strings or by a pervading elastic medium, any movement of one of these bodies necessarily involves a change of stress between all of them. A push on one means a pull of exactly equal amount on others. There can be no push without a resistance, and this resistance is a

Publications received at Editor's Office, Feb. 17-22.

KANSAS Academy of Science, Transactions of the Twentieth and Twenty-first Annual Meetings of the, 1887-88. Vol. XI. Topeka, State. 127 p. 8°.

U. S. COAST AND GEODETIC SURVEY. Chart showing Annual Change of the Magnetic Declination for the Epoch January, 1890. Washington, Government. Scale 1 : 10,000,000.

——Chart showing Magnetic Meridians of the United States for January, 1890. Washington, Government. Scale 1 : 10,000,000.

——Isogonic Chart for the Epoch 1890. Alaska and Adjacent Regions. Washington, Government. Scale 1 : 13,700,000.

——Isogonic Chart of the United States for the Epoch 1890. Washington, Government. Scale 1 : 7,000,000.

WARD, H. M. Diseases of Plants. London, Society for promoting Christian Knowledge; New York, E. & J. B. Young & Co. 196 p. 16°. $1.

WAUTERS, A. J. Stanley's Emin Pasha Expedition. Philadelphia, Lippincott. 378 p. 12°. $2.

WEDDERBURN, A. J. A Popular Treatise on the Extent and Character of Food Adulterations. (U. S. Dept. Agric., Bulletin No. 25.) Washington, Government. 61 p. 8°.

WHIST, American, Illustrated. By G. W. P. Boston and New York, Houghton, Mifflin, & Co. 367 p. 16°. $1.75.

quality of the elastic medium given to it by the mere presence of the other body. We have seen, in the case of the two bodies connected by an elastic string, that the stress is due to the relative positions of the two bodies. They were brought into their position by motion; but, so soon as this motion was overcome by the elastic resistance of the string, the force applied became potential, not kinetic.

Now, supposing one of these bodies to remain stationary while the other is moved farther away, the stress between the two is increased. The push on the one has increased the pull on the other, yet there has been no motion of the latter. The only motion there was in the system was that imparted to the former; and the motion was away from the latter, not towards it. A new static condition has been induced upon both of them, but can it be said to have been propagated from one to the other? I do not think it can.

Now, these two bodies thus connected may be moved from one place to another, yet, so long as they maintain their same relative positions, the stress or tension of the elastic between them will not vary. So, if a form of stress between two bodies in space may be conceived to be entirely independent of the presence of any other bodies in space, a relative motion of these two bodies between themselves involves a change of stress without propagation; and, again, if these two be relatively still, they may move relatively to all other bodies without changing their stress or altering their static condition with regard to stress; yet in one sense (and I conceive in this sense alone) is the stress properly said to be propagated.

Professor Dolbear says, "One may call it potential or kinetic energy if he chooses: a static condition will presently be reached, but not instantly."

Right here, I suppose, lies the gist of the whole thing. The point I wished to make was that Professor Dolbear did not distinguish between the condition of the medium in the two states of motion and rest. A potential condition involves motion only in so far as motion was necessary to bring it into being. It may in one sense be considered as stored-up motion, as it is capable of giving out again an equivalent quantity o motion, but it is not motion itself. He implies, and I agree with him, that motion precedes the potential condition. Now, this motion, or energy if you choose, may be of any known kind (not necessarily electrical, but may be); and when, by reason of the work done, we have produced a condition of matter of a certain kind, — when all the work has been done, — we have a conditon that is called electrification.

What I have been contending for is that the magnetic field and the fields of electrification and gravity are those fields when they are established (before that, in the interval during which they are being established, the fields are kinetic, not potential); that in the case of electrification the movement necessary or involved in its establishment is not the electric field, but is the electric current which can be propagated, and the condition of stress produced by that motion is the electric field.

It is possible, however, that I have not fully understood him. Perhaps he means something like this: imagine, for instance, a row of material points numbered from 1 to 10 spread out in a row, and connected by elastic thread. If 1 and 10 are stationary, and the intermediate numbers are strung along the string, the tension upon the string is uniform throughout its length. If, now, No. 1 be moved a little farther from No. 2 than originally, the tension on the string between the two would be greater than before. This would cause a slight movement of No. 2; and so on to No. 10, which we have imagined stationary. Would it take *time* for the pull on No. 1 to become apparent on No. 10? It would with all material elastics, because of their viscosity and inertia; but, if we use as our elastic the luminiferous ether, I maintain that it would not, for one of the main features assigned to it is absolute and perfect elasticity. If No. 1 were pushed nearer to No 2, the lessening tension would exist at No. 10 at the same instant, because another property of the ether is absolute incompressibility.

Taking this latter characteristic of the ether, — incompressibility, — if we had a long pole (say, a thousand miles long), if we should cause one molecule of that pole to change its position, would not every other molecule, even those a thousand miles away, be caused to move also? and would there be any time lost in their responding? Or, to put it in another way, if we should premise that the farthermost molecule should not move, would it be possible in any way to move the nearer molecules? I contend that it would not, and that if one moved, all must move.

He says, "Mr. Perry seems to say, that, if there was but one body in the universe, it could not have an electric field, even if it could be electrified." That is not my statement, nor is it my idea. My idea is, that in the case of static fields, under which head I would include electrification, magnetism, and gravity, two exactly equal and opposite conditions are inevitable. I cannot conceive of there being a push without there being a corresponding and equivalent pull, without the destruction of equilibrium; and, if the equilibrium be destroyed, we have motion which may be in any direction whatever. This is what I conceive to be the difference between the two kinds of fields. As before stated, I do not believe a pull can exist without a corresponding push and yet maintain equilibrium. If the one exceeds the other, there will be motion towards the greater, — there will be more positive than negative electricity; there will be more north-seeking magnetism than south-seeking magnetism, or *vice versa;* and by the same token one may exist without the other. By the same course of reasoning, if a stress can be propagated (as I use the term "stress"), there is implied an existence of one form (the positive) before the existence of the other (the negative), as the element of time is involved. Faraday distinctly states that there cannot be an absolute charge of matter. I stated my belief that a stress could not exist unless there were two particles. I should also have added that there must be a connecting medium between those two particles. If this be so, then it is clear without reasoning, that, if either one of the particles or the connecting medium be wanting, the conditions for stress are wanting, and it cannot exist. A material body having two points and a connecting medium between the two is therefore capable of either magnetism or electrification. If one of the points be wanting, and energy be applied to the other, this energy, instead of being stored up by the tension of the elastic medium, and producing stress as before, — which would be capable of giving out again an equivalent amount of energy or motion, which stress might constitute electrification or magnetism,—produces no stress, but motion at once, which may be heat, light, or the electric current, or give rise to these.

Again: if there were but a single body in space, its physical field would, I think, be confined within itself, and not radiate outward indefinitely. Let us imagine space to consist of an elastic jelly: then all particles of matter in space are connected with each other by elastic bonds. One particle cannot be moved from its position without setting up stresses in space between itself and all the other particles. But it is evident that the algebraic sum of all the stresses is zero. If the stress be wholly positive on one body or particle, the stresses on all the other particles will be negative and exactly equal in amount, whether there be a million or only one other particle. If there be but one other particle or body, all of the negative stress — electricity, if you choose — will be upon it, or perhaps rather in the medium joining the two. Now, since the stress lies wholly between these two (they are in no way connected with any other particles, or, in other words, they are the only two particles in space), they may be moved in any way, providing their positions relatively to each other remain the same, without altering the stress of the surrounding medium. Since they do move, there is kinetic energy; but this movement does not alter their relations to other particles, because there are no other particles: hence no additional stresses are set up. Their movement does not convert the potential energy stored up between them into kinetic energy, although a movement of one relative to the other would do so; and the resulting kinetic

energy would represent the difference between the initial and final potential states of the system.

He quotes Tait as saying, "Every action between two bodies is a stress," and says that "the body and the ether about it are two bodies, and, if they can act at all upon each other, there will then be a field." But you will recollect that he makes this statement in controversion of mine, that, if there were but "a single mathematical point in space, there could be no stress." I said nothing at all about there being such a thing as ether in this connection, though I see the necessity of including it, and also the force of his argument; but I do not think Tait meant to consider the ether as a body in the sense in which Professor Dolbear here uses it. As I understand it, Faraday, Maxwell, Thomson, and I assume Tait also, believe the dielectric to be the active agent, and the conductor the passive agent, in all the phenomena which we are considering. The dielectric, whatever it may be, — the ether, if you will, — is really the seat of the strains which terminate in the two bodies connected. I think Tait used the term in the sense that I have indicated.

"Perhaps, however, Mr. Perry calls the ether matter, which has not been my habit, and against which I was not on my guard when I wrote the statement to which he objects. Until we have some evidence that ether is subject to the law of gravitation, it seems to me to be improper to speak of it as matter. If every particle of matter attracts every other particle of matter, and if there is no evidence that ether is so attracted, it is not conducive to good terminology to call it matter."

Let us see what authority we have for considering ether as matter. I believe the weight of opinion is either that the ether is a form of matter or that matter is a form of ether. Sir William Thomson believes that matter is nothing but ether; that it is composed of it. We know this all-pervading medium as ether when it is unorganized. When it is organized into vortex rings, we have the atom and molecule, hence gross matter, as it is usually distinguished. I am of the opinion that Sir William Thomson's theory of matter is the most popular one at present. In 1838 M. Pouillet found that the heat-energy transmitted from the sun to the earth would, if none were absorbed by our atmosphere, raise 1.76 grams of water 1° C. in 1 minute on each square centimetre of the earth normally exposed to the rays of the sun. This is equivalent to 83.5 foot-pounds of energy per second. This figure Sir William Thomson used in determining the probable density of the ether.

Herschel estimated the stress (elasticity?) of the ether at $17 \times 10^9$ pounds per square inch. S. Tolver Preston estimates the probable inferior limit of the tension of the ether at 500 tons per square inch, which is much smaller than Herschel's estimate. Young remarks, "The luminiferous ether pervading all space is not only highly elastic, but absolutely solid." I do not understand the meaning attaching to "solid" here, but it is evidently an attribute of matter. Sir William Thomson, calculating upon the data above referred to, finds the weight of a cubic foot of ether to be $\frac{3}{5} \times 10^{-20}$ pounds. Bellini makes it $\frac{1}{2} \times 10^{-13}$ pounds. M. Herwitz, another investigator, arbitrarily assumes a cubic foot of ether to weigh $10^{-18}$ pounds.

De Volson Wood treats the ether as if it conformed to the kinetic theory of gases, which, with other assumptions, is equivalent to considering it as gaseous in its nature, and at once compels him to consider it as molecular. He says, "The electro-magnetic theory of light suggested by Maxwell (?), as well as the views of Newton, Thomson, Herschel, Preston, and others, are all in keeping with the molecular hypothesis."

Professor Rood succeeded in producing a vacuum of $\frac{1}{390,000,000}$ of an atmosphere. Professor De Volson Wood states, that, even at this great rarity of the atmosphere, the quantity of matter in a cubic foot of air "would be some 200 million million times the quantity in a cubic foot of ether," and says, that, admitting that the ether is subject to attraction according to the Newtonian law and of compression according to the law of Mariotte, in order to make the density vary sensibly with the distance, the attraction of the central body must be something like a million times as great as that of the sun, or have a diameter a million times as large; but, there being no such known body, he concludes that the density and tension of the ether may be considered uniform throughout space; and he says that the weight of a given volume of it would vary as the force of gravity, and places the weight of a cubic foot of ether at the surface of the sun at $57 \times 10^{-24}$ pounds, and estimates the pressure on a square foot of the sun of a column of infinite height at $13 \times 10^{-14}$ pounds.

Thus we see, that, while no two of these investigators agree in their results, they all agree in ascribing to the ether all the properties of matter, including that of gravity, and I therefore think it no violation of the proprieties to speak of it as though it were matter.

In regard to the definition of the word "stress," Professor Dolbear quotes Maxwell as follows: "Now, we are unable to conceive of propagation in time except either as the flight of a material substance through space or the propagation of a condition of motion or stress in a medium already existing in space," and says, "Evidently Maxwell did conceive that stress could travel." I freely admit that a "condition of stress" may travel, in the sense that a body between the particles of which there exists a stress may travel; and it seems to me that is what Maxwell means. If he meant what Professor Dolbear thinks he does, why does he says a "condition of stress"? Why not simply "stress"?

I think Maxwell was probably the first to use the term "stress," but it was in relation to phenomena described by Faraday. In regard to this, Maxwell himself says (vol. i. p. 153), "The distribution of stress considered in this chapter is precisely that to which Faraday was led in his investigation of induction through dielectrics." Further, he says, "This is an exact account of the conclusions to which we have been conducted by our mathematical investigation. At every point of the medium there is a state of stress such that there is tension along the lines of force, and pressure in all directions at right angles to these lines." "The expression 'electric tension' has been used in various senses by different writers. I shall always use it to denote the tension along the lines of force, which, as we have seen, varies from point to point, and is always proportional to the square of the resultant force at the point." "The hypothesis that a state of stress of this kind exists in a fluid dielectric," etc. "The state of stress which we have been studying." "If the medium is not a perfect insulator, the state of constraint which we call electric polarization is continually giving away. The medium yields to the electro-motive force, the electric stress is relaxed, and the potential energy of the state of constraint is converted into heat." "In the phenomenon called the electric current, the constant passage of electricity through the medium tends to restore the state of polarization as fast as the conductivity of the medium allows it to decay. Thus the external agency which maintains the current is always doing work in restoring the polarization of the medium which is continually becoming relaxed, and the potential energy of this polarization is continually being transferred into heat."

I consider the above as perfectly in accord with my statements in your issue of Jan 24.

On p. 257, § 642, he specifically defines "stress" as follows: "Hence the state of stress may be considered as compounded of (1) a pressure equal in all directions, (2) a tension along the line bisecting the angle between the directions of the magnetic force and the magnetic induction, (3) a couple tending to turn every element of the substance," etc. "The stress in this case is therefore a hydrostatic pressure, combined with a longitudinal tension along the lines of force," etc.

But Faraday was the first to conceive of these stresses, although I am not sure that he used this term. In his "Experimental Researches," 3249, he says, "With the electric force we have both the static and dynamic state; . . . still there are well-established electric conditions and effects which the words 'static,' 'dynamic,' and 'current' are generally

employed to express. . . . The lines of force of the static condition of electricity are present in all cases of induction. . . . No condition of quality or polarity has as yet been discovered in the line of static electric force, nor has any relation of time been established in respect of it.'' ''No relation of time to the lines of magnetic force has as yet been discovered'' (*Ibid.*, 3253).

Finally, on pp. 439 and 440 of ''Experimental Researches'' (vol. iii. edition of 1855), he gives in detail, too long for quotation here, his views of the different phenomena, which, it seems to me, fully support the position I have taken in this matter.

NELSON W. PERRY.

Cincinnati, O., Feb. 17.

### Supposed Aboriginal Fish-Weirs in Naaman's Creek, near Claymont, Del.

IF the substituted letter of Mr. Hilborne T. Cresson to the *American Antiquarian*, published in your issue of Feb. 14, had ever been printed before, certainly I should not have received the impression that Mr. Cresson once fancied he had discovered the remains of pile-dwellings at Naaman's Creek, on the Delaware. The differences between the two versions are very striking to whoever takes the trouble of comparing them. I never before understood that Mr. Cresson regarded the version of his letter published in the *Antiquarian* in November, 1887, as ''an atrociously garbled version'' of it. I supposed he only complained of certain bad mistakes in the proof-reading, such as the substitution of ''cave'' for ''cove,'' etc. Mr. Cresson's memory has played him false in regard to what he wrote to me when he kindly forwarded to me a selection of the objects discovered at the three ''stations.'' On referring to the notes that accompanied the specimens, I find that he calls them ''pile-structures.'' The fact is, that I supposed Mr. Cresson had changed his mind in regard to what these structures actually were; and as I had formed the opinion upon first reading what he had printed respecting them, that they were merely remains of Indian fish-weirs, I simply made that statement. I found nothing in what Professor Putnam had stated in the ''Reports of the Peabody Museum'' (vol. iv. p. 44) in regard to Mr. Cresson's discoveries to give me any different impression. Mr. Cresson's letter to me, to which he refers, containing the request that I should adopt his corrected views, came too late, as I wrote to him, because my manuscript was already in the printer's hands. That I should have drawn such inferences about Mr. Cresson's opinions does not seem to me so ''inexplicable'' as it does to him.

HENRY W. HAYNES.

Boston, Feb. 16.

MR. H. T. CRESSON, in his letter published in *Science*, Feb. 14, seems to want to get away from his own assertion, and so takes the opportunity to abuse the editor of the *American Antiquarian*. If you will allow me to quote the very words which he used in his letter, and which were published in the *Antiquarian* exactly as they were written, without any change whatever, your readers will see what his position was in the year 1887, though he seems to have changed his opinion since that time. The words are as follows:—

'' The results so far seem to indicate that the ends of the piles embedded in the mud, judging from the implements and other *débris* scattered around them, once supported *shelters of early man that were erected a few feet above the water*—the upper portions of the *piles* having disappeared in the long lapse of time that must have ensued since they were placed there — (the flats are covered by four and one-half feet of water on the flood tide; on the ebb the marsh is dry and covered with slimy ooze several feet in depth, varying in different places). Three different *dwellings* have been located, all that exist in the flats referred to after a careful examination within the last four years of nearly every inch of ground carefully laid off and examined in sections.

'' The implements found in *two* of 'the supposed *river dwelling sites*,' are very rude in type, and generally made of dense argillite, not unlike the palæoliths found by my friend Dr. C. C. Abbott in the Trenton gravels.

'' The character of the implements from the other or third supposed *river dwelling* on the Delaware marshes are better finished objects made of argillite, indicating a greater antiquity than ordinary surface found Indian relics. At this *pile dwelling* a human tooth has been found and fragments of a jaw bone, ends of scapulæ, etc. It is my intention later on to present my specimens to the Peabody Museum of Ethnology and Archæology at Cambridge, Mass.''

The above is a quotation from the letter published in the *American Antiquarian* in 1887. Mr. Cresson desires the readers of *Science* to compare the two letters. In order that they may do so, I quote a part of the letter which appeared in *Science*, Feb. 14 (see p. 116, near the bottom of the page). It is as follows:—

'' The results, so far (1877), seem to indicate that the ends of piles embedded in the mud, judging from the implements and other *débris* scattered around them, had once served as supports to structures intended for *fish-weirs*, these in all probability projecting a few feet above the water, and were no doubt interlaced with wattles, or vines, to more readily bar the passage of fish from the creek into the river. The upper portion of these *wooden structures* has entirely disappeared in the long lapse of time that has ensued since they were placed there. . . . At slack water it forms a low mud-bank slanting toward the creek. Three different *stations* were located, probably all that exist, in the bed of the creek referred to. This opinion is based upon careful examinations, made within the past four years, of nearly every inch of ground in the neighborhood of the wooden stake-ends, by dredging in sections between certain points marked upon the creek's bank. The implements found in one of the *stations* are generally made of argillite, with a few of quartz and quartzite. Some were very rude in character, and not unlike the palæoliths found by Dr. C. C. Abbott in the Trenton gravels. Objects of stone and pottery rather better in finish than those at *station* A have been found at the two other *stations*, B and C.''

This is a quotation from *Science*, the sentences being consecutive. The Italics will show the words and clauses which in one letter convey one impression, and in the other letter convey an entirely different impression.

Mr. Cresson charges the editor with putting in the words ''shelters of early man that were erected a few feet above the water,'' ''three different dwellings,'' ''two of the supposed river dwelling sites,'' ''The character of the implements from the other or third supposed river dwelling on the Delaware marshes are better finished objects made of argillite, *indicating a greater antiquity* than ordinary surface found Indian relics. At this *pile dwelling* a human tooth has been found and fragments of a jaw bone, ends of scapulæ, etc.'' Now, the editor of the *American Antiquarian* does not pretend to be ingenious enough to fabricate such sentences, and interpolate them into a letter. It is beyond the skill of an ordinary man to interpolate remarks of that kind. If these words are not contained in the copy which Mr. Cresson says he kept, why did not Mr. Cresson change the wording, or request that it should be corrected, in the two years that have elapsed? Professor Haynes quoted from the *American Antiquarian*, supposing that Mr. Cresson's own words were to be relied upon. The statement went into ''The Critical and Narrative History'' on the strength of Mr. Cresson's own words. The editor of the *Antiquarian* at the time said nothing about the ''find.'' If Mr. Cresson wishes to withdraw from the position taken, he is at liberty to do so, but he should not charge the editor of the *Antiquarian* with ''garbling'' or changing his letter, unless he can prove it.

STEPHEN D. PEET.

Mendon, Ill., Feb. 18.

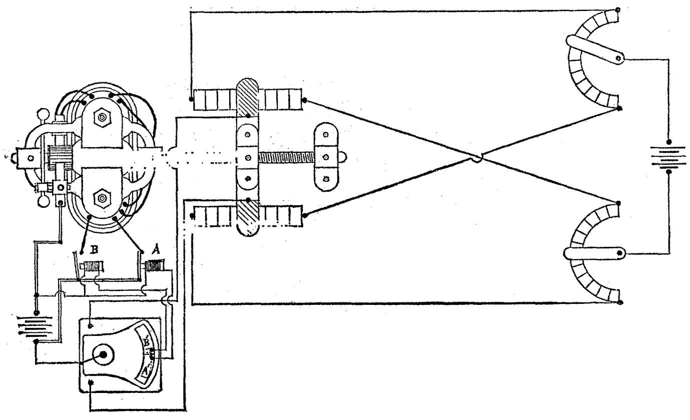
### The Fiske Range-Finder.

I WAS much interested in the description of the Fiske range-finder, which appeared in *Science* on Jan. 24. There is much credit due Lieut. Bradley A. Fiske for the ingenious manner in which he has applied a most beautiful electrical combination to a practical purpose, and there is no doubt that its range of usefulness will extend beyond the realms of gunnery practice.

While reading the article, an idea came into my mind, which may also have occurred to Lieut. Fiske, and been rejected as im-

practical; yet I think I will speak of it, as I see no reason why it could not be applied with success, and still further increase the effectiveness of the range-finder. The object is to make the range-finder self-recording, to automatically adjust the balance, and to avoid the need of a third operator. The method is extremely simple. First, the "slider" is provided with a nut through which a spindle revolves, the spindle being the continuation of a small motor-shaft. The fields are wound with two coils in such a manner, that, when the circuit is closed through one, the motor revolves in a particular direction, and, when closed through the other, in the opposite direction; moving the slider backward or forward, as the conditions might require, to establish the balance. The motor is fed from one cell of storage or other battery, at about two volts potential.

The operating mechanism is equally simple. Two small magnets, $A$ and $B$, are connected to the same cell that supplies the motor, and the return wire of each terminates in a drop of mercury, $A'$ and $B'$, located each side of the galvanometer-needle, so that the least movement to one side or the other will cause contact with the globule of mercury. The circuit thus being closed through the needle to the other pole of the battery, the




corresponding magnet becomes energized, attracting the armature, which closes the corresponding circuit of the motor. The object of the magnets $A$ and $B$ is to reduce the sparking at $A'$ and $B'$, and they might possibly be dispensed with. They were to be wound with considerable resistance, that the current might be so small as to prevent any trouble at $A'$ and $B'$ by burning or sticking of the contacts.

There are other arrangements whereby the above result might be accomplished, but I send this, as it may be of some interest should this plan of automatically adjusting the balance not have been previously thought of. J. F. Denison.

New Haven, Conn., Feb. 15.

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### Soils and Alkali.

Please grant me the use of your paper to reply to the article by Dr. Stockbridge in your issue of Jan. 17, on soils and alkali. When the bulletin was written, it was thought best to preface it with some general statements about soils. With this end in view, I collected, condensed, and arranged, from the sources at my command, the facts of the first eight pages of the bulletin. There never has been any claim made to originality in these eight pages. The facts were collected simply to make the bulletin more intelligible to the farmers. As far as I knew, I tried to give credit to every one for his work. The domain of science is too large, and human life is too short, to have any one mind even comprehend it. It was explained to Dr. Stockbridge that I did not collect all the material myself, and, if any of the matter was his, due credit would be given him. This should convince any man that I acted in good faith in the matter. He makes some very broad assumptions, that are not warranted in this day, age, and generation: 1st, That he has a patent right on German and other foreign publications, and that no one else has access to them; 2d, That no one else can translate them; 3d, If he translated them, and any one afterwards uses the facts, credit must be given to Dr. Stockbridge, and not to the author. When I use the facts of Dietrich, Hoffman, Liebenberg, or any other man, and I give him credit, my duty ends then: Dr. Stockbridge ha no claim to them, even though he may have translated them.

The statements in the eight pages referred to are commonplace, and are found in any good modern text-book that treats of the subject.

Nitrification is described in great detail in Part II. of the third supplement to Watt's "Dictionary of Chemistry" (p. 1397); also in Bloxam's "Chemistry" (p. 173) and Storer's "Agriculture" (vol. i. p. 298). The word "microbe" ("little life") was first used by Sédillot. The latest investigators are Warrington, Schlösing, and Müntz. The per cent of ash in plants is given in "How Crops Grow," by Johnson (p. 30); "How Crops Feed," by the same author (p. 364); "Chemistry of the Farm," by Warrington (p. 2). "Aschen Analysen Von Landwirthschaftliche Prouducten," by Wolff, gives 5 per cent of ash. "The Geological Survey of Ohio, 1870," p. 368, the average of 151 analyses, gives 4.84 per cent of ash. It has been thought that the transpiration of plants has been worked out in greater detail than any other subject. Nearly every possible condition has been investigated by some one. The law of transpiration from the upper and lower portions of the leaves has been worked out by Guettard, Unger, and Bonnet. The relation between the number of stomata and the rapidity of transpiration has been experimented upon by Von Höhnel and Garreau; the amount in wet and dry weather, by Moldenhawar; the effects of light and darkness, by Wiesnar and Van Tieghem; how transpiration is influenced by the liquid absorbed, by Sénébier, Sachs, and Burgerstein; the pressure in the growing plant during transpiration, by Meyen, Sachs, and Von Höhnel; even the effect of the different rays of the sun, by Wiesner; and the age of the leaves, by Höhnel and Dehérain. The amount of water transpired for wheat, barley, oats, beans, red clover, rye, peas, etc., has been determined by Hellriegel, while Sachs, Hofmeister, and Hales have determined the amount transpired from the grape-vine, sunflower, cabbage, etc.

The facts about the fineness or division of soil are stated in Williams's "Applied Geology" (p. 111). In "Chemical Bulletin, No. 10, Department of Agriculture," under the head (p. 10) "The General Fertility of Soils depends Principally on Their Texture," is the following language: "These qualities depend altogether on the state of division of the soil and of its geological origin" (see "Soils of the Farm," by Scott and Morton). When the same statement has been made by so many authors, it is difficult to state positively the source of information; but in two instances I had the references marked.

He quotes me:—

O'BRINE (p. 9).

The heat comes from three sources: Solar heat, as the sun's rays; heat of chemical decomposition within the soil, and the original heat of the earth's interior. The latter cannot be of any value to plants; the heat of chemical decomposition is not of any value, except in a few special cases. The sun, therefore, remains the only source of heat of practical importance in relation to the production of crops from the soil.

In Dana's "Manual of Geology," 1879, p. 714, this language is found:—

The earth has three prominent sources of heat: (1) The sun; (2) The heat of the earth's interior; (3) Chemical and mechanical action.

In making the application of these facts to plants, what other conclusion could be arrived at?

He quotes me:—

O'BRINE (p. 4).

Oats, rye and buckwheat thrive with the lowest amount of organic matter, requiring from one to two per cent. Wheat and tobacco seem to require most among the common agricultural products, and do their best upon soils containing from five to eight per cent of organic matter.

The text-book of geology by Geikie, 1885, p. 326, in speaking about the organic matter in soils, says,—

It is the experience of practical agriculturists in Britain that oats, rye, will grow upon a soil with one and one-half per cent of organic matter, but that wheat requires from four to eight per cent.

I added to the statement in the geology, "buckwheat and tobacco;" the one being proverbial for growing on poor soil, and the other for requiring a rich soil. The order of arrangement that I used is found in Loudon's "Encyclopædia of Agriculture," eighth edition.

He claims, in his article, that the facts I used are his, while in the preface to his book he lays no claim to the facts. Here is what he says: "The nature of the work is such that I have no claim for the presentation of new material." In regard to "Rocks and Soils," published by Dr. Stockbridge, I have lately examined it, and I can confirm what he has said, that it does not contain a single fact new to science. I believe *one* such claim is made, but the *facts* have been in print for *forty years*. We have the same publisher, and for that reason I do not care to make any comments upon it. Any of your readers that are interested will find a review of it in *Nature*, Jan. 24, 1889, p. 292.

D. O'BRINE.

Fort Collins, Col., Feb. 15.

## INDUSTRIAL NOTES.

### The Electric Light in Japan.

AN American electric-light system has again come out victoriously while competing with the older European systems. This time the battle-ground was Tokio, Japan, where a corporation of capitalists, The Takata Company, awarded a large contract for electric lighting to the Westinghouse Electric Company of Pittsburgh, Penn. The Westinghouse alternating-current system has gained great favor in eastern Asia, as an immense central station for electric lighting is now being installed with Westinghouse alternating-current apparatus in Canton, China. The Japanese plant will be put up at Shidznoka, near Tokio, and it will have a total capacity of 500 lights. This is the first alternating-current central-station plant in the land of the Mikado.

### A Big Road goes in for Electricity.

DURING the last week Mr. Thomas Lowry, president of one of the largest street-railway combinations in the world, showed his confidence in the electric system of street-railway propulsion by deciding to equip all the lines of St. Paul and Minneapolis by electricity. The electric company to whom this contract was awarded is the Sprague Electric Railway and Motor Company, and the investment called for from the street-railway company is said to be in the neighborhood of two million dollars.

Before deciding upon any system to be used upon these roads, the president of the company, together with the directors, made a careful inspection of all the different methods of operating street-cars in large cities, and investigated the merits of each. As a result of this investigation, the contracts for the partial equipments of the road by cable were cancelled, and negotiations were entered into with the Sprague Company for the entire electrical equipment.

By the terms of the contract, the Sprague Company is to fully equip and put into working order the entire mileage owned by the railway company, the work to be completed by June 1; and the first delivery of electric-railway apparatus, which will include 360 Sprague improved motors for the equipment of the rolling-stock, will be made shortly.

This is probably the largest order which has ever been given for electric-railway motors, and evinces the confidence which prominent street-railway managers feel in the electric system.

### Photography done Quickly.

THE initial letters of the above three words have been adopted as the name of the "P. D. Q." camera, a new detective camera of small size, manufactured by E. & H. T. Anthony of this city. This camera, which is shown in the cut, is adapted to the making of four-by-five inch pictures, either time or


THE P. D. Q CAMERA.

instantaneous, and which may be taken either vertically or horizontally. It is provided with a finder which may be used for either position. Three patent double holders are supplied with each camera, — one for dry plates and two for films. The double-film holders are very durable and compact, being only three-eighths of an inch thick.

This camera is fitted with a combination instantaneous achromatic landscape lens and a shutter of a new design, which by its peculiar mechanism is always closed except at the moment of exposure, the resetting being accomplished by an ingenious device, which requires only the movement of a lever to the right or left. The manipulation of the shutter is wholly from the outside of the box, and it may be made to work with greater or less rapidity, as desired.

CALENDAR OF SOCIETIES.

**Anthropological Society, Washington.**

Feb. 18.— D. S. Lamb, Olecranon Foramen; W. W. Rockhill, Tibet; Mark B. Kerr, The Origin of Llao Nous, a Legend of the Shasta.

**Engineers' Club, St. Louis.**

Feb. 19. — Professor Johnson read Mr. Edward H. Connor's paper on the "Substructure of the Cairo Bridge." The paper was accompanied by drawings, showing the spans, piers, and caissons; also by numerous tables, and the complete specifications of the bridge. The paper explained the work of construction in detail, and the difficulties met with in various parts of the work. The tables gave the results of numerous tests on cements, showing the effect of different proportions of salt, the effect of freezing, the effect of fine grinding, etc. The results were given for both Portland and Louisville cements. Under general discussion, Mr. Willard Beahan was called upon for some information regarding the outlook for engineers in South America, he having recently returned from that country. He stated that the prospects for American engineers were excellent at the present time. Railroads are few, but a large number are in prospect. Municipal engineering was just being taken up. The prices secured and salaries paid were good. Most of the engineers now in that country are French, there being only a few from America and England.

**Exchanges.**

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn.

I wish to exchange or purchase well-fixed or hardened vertebrate embryos for sectioning. Desire specially reptilian embryos, but will be glad to secure any material that I do not possess. Thomas G. Lee, M.D., Histological Laboratory, Yale University, New Haven, Conn.

Wanted—Books and journals, American or foreign. relating to Photography—exchange or purchase. C. W, Canfield, 1,321 Broadway, New York.

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection. — F. C. Browne, Framingham, Mass., Box 50.

D. E. Willard, Curator of the Museum, Albion Academy, Albion, Wis., will answer all his correspondence as soon as possible. Sickness and death in the family, with many other matters, have prevented his answering as promptly as he should have done.

I will give 100 good arrow heads for a fine pair of wild cattle horns at least two feet long. If you have shorter or other horns write me, and also how many arrow heads you want for them. I will also exchange shells, minerals and arrows. W. F. Lerch, 308 East 4th St., Davenport, Iowa.

A few duplicates of *Murex radix, M. ramosus, M. brandaris, Cassis rufa. Harpa ventricosa, Oliva triatula, O. reticularis, Chlorostoma funebrale, Cypræa caput serpentis, C. lynx, Lottia gigantea, Acmola patina, Chama spinosa*, and some thirty other species, for exchange for shells not in our collection. List on application. — Curator Museum, Polytechnic Society, Louisville, Ky.

Photographs and Stereoscopic views of Aborigines of any country, and fine landscapes.etc.,wanted in exchange for minerals and fossils. — L. L. Lewis, Copenhagen, New York.

Droysen's *Algemeiner Historicher Hand-atlas* (Leipzig, 1886.) for scientific books — those published in the *International Scientific Series* preferred.—James H. Stoller, Schenectady, N.Y.

Astronomical works and reports wanted in exchange or to buy. Reports of observations on the planet Neptune and its satellite specially desired. — Edmund J. Sheridan, B.A., 295 Adelphi St., Brooklyn, N.Y.

I would like to correspond with any person having Tryon's "Structural and Systematic Conchology" to dispose of. I wish also to obtain State or U.S. Reports on Geology, Conchology, and Archæology. I will exchange classified specimens or pay cash. Also wanted a copy of MacFarlane's "Geologists' Traveling Hand-Book and Geological Railway Guide." — D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakesperiana ; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics.— D. E. Willard, Albion Academy, Albion, Wis.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.